Service & Calibration Manual

A2

Audio Test & Service System

Version 2.21 / Sep 08 / ben

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SAFETY & WARNINGS

THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED DURING ALL PHASES OF OPERATION, SERVICE AND REPAIR OF THIS INSTRUMENT. FAILURE TO COMPLY WITH THESE PRECAUTIONS OR WITH SPECIFIC WARNINGS ELSEWHERE IN THIS MANUAL VIOLATES SAFETY STANDARDS OF DESIGN, MANUFACTURE, AND INTENDED USE OF THE INSTRUMENT. *NTI* ASSUMES THAT NO LIABILITY FOR THE CUSTOMER'S FAILURE TO COMPLY WITH THESE REQUIREMENTS.

TO AVOID SHOCK HAZARD, THE INSTRUMENT CHASSIS AND CABINET MUST BE CONNECTED TO AN ELECTRICAL GROUND. THE INSTRUMENT IS EQUIPPED WITH A THREE CONDUCTOR AC POWER CABLE. THE POWER CABLE MUST EITHER BE PLUGGED INTO AN APPROVED THREE CONTACT ELECTRICAL OUTLET OR USED WITH A TWO CONDUCTOR CABLE WITH THE GROUNDING WIRE FIRMLY CONNECTED TO AN ELECTRICAL GROUND. DO NOT OPERATE THE INSTRUMENT WITHOUT THE GROUND WIRE FIRMLY CONNECTED TO THE GROUND SYSTEM.

DO NOT ATTEMPT TO SERVICE THE INSTRUMENT UNLESS PROPERLY QUALIFIED. SERVICE SHOULD ONLY BE PERFORMED BY TRAINED, QUALIFIED TECHNICIAN, *NTI* OR AN APPROVED *NTI* SERVICE AGENT.

DO NOT SUBSTITUTE PARTS OR MAKE MODIFICATIONS WITHOUT THE WRITTEN APPROVAL OF *NTI*.

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1. GENERAL INFORMATION

Introduction

This service manual supports the **A2** with all configurations and serial number ranges produced by NTI. Throughout the production a major revision in the PCB layouts has been done with serial number 400 onwards.

HINT

At the end of the manual, two complete sets of schematic diagrams and assembly drawings are provided. The first set is related to A2 instruments with serial numbers <400 while the second set applies to instruments with serial numbers >400.

NOTE	**Please check the serial number of your A2 before you start working! The serial number is labeled at the rear side of the instrument.**

SERIES <400	Concerns A2 units with S/N between 100 and 399.
SERIES >400	Concerns A2 units with S/N equal or above 400.

Product description

The NTI A2 is a comprehensive high performance two-channel test instrument providing both a generator and an analyzer to perform all required audio tests. The generator is based on a Digital Signal Processor (DSP) providing a very low distortion sine signal in the range from 10Hz to 100kHz and a variety of alternate signals in the frequency range from 10Hz to 40kHz. The level of the generator can be adjusted over an extremely wide range from 10µVrms up to 30Vrms. The output impedance is selectable and both channels are electronically balanced and individually mutable.

The analyzer measurement functions provided are

- Level absolute (2-channel) in µV, mV, V, dBV and dBu or dBm
- Level relative (2-channel) in *1, % and dBr
- Selective Level in µV, mV, V, dBV and dBu or dBm
- Total harmonic distortion & noise (THD+N) in % and dB
- IMD (Intermodulation distortion) in % and dB
- Wow and Flutter in %
- Noise (absolute) weighted and unweighted in µVq, mVq, Vq and dBq
- Noise (relative) weighted and unweighted in *1, % and dBr
- Crosstalk frequency selective in *1, % and dBr
- Frequency (2 channels simultaneously)
- Phase (inter-channel) in the range of ±180° degree.

An input level meter reports the AC input level independent of the selected measurement function. BNC connectors provide the normalized input signals of both channels as well as the reading signal before the internal rectifier. The same signal is also fed to the internal loudspeaker for monitoring purpose.

Various filters are provided for the different measurement functions such as 22Hz to 22kHz Audio Bandpass filter, 400Hz Highpass filter, noise weighting filter according to CCIR-468/3. Optional filter can be installed.

Measurements can be displayed as single measurement results in the METER mode, providing the measurement result in large character in digital terms as well as in an analogue bargraph. Generator settings are continuously display in the top of the display. Additional information such as input levels, frequencies and impedances are displayed in the bottom status line.
A high resolution Graph display allows to perform and display all types of sweeps over the entire frequency/level range of the internal generator. Supported sweep types are:

- Frequency sweep
- Stepped frequency sweeps with a fixed duration of each step
- Externally controlled frequency sweep
- Amplitude sweep
- Time sweep
- Table sweeps (frequency and level can be defined)

Internal non-volatile memory provides storage capacity for up to 24 traces in up to four complete graphs.
Display mode SCOPE provides a dual channel storage oscilloscope to watch audio signals in the time domain. A very helpful tool for diagnostic purpose.

A parallel printer port supporting various printer drivers, allows to do printout of all the display modes.

Options

AO1 RS232 interface with software package AS03. Allows remote control of the A2 and enhances the functions of the instruments. A very easy to learn programming language (AMSL) allows to build up automated sequences and PASS/FAIL tests. Demo disk available.

AO4 A-weighting filter according to IEC 651. The filter can be inserted into the signal path in function LEVEL to allow RMS-rectified A-weighted measurements.

AO5 User definable filter. A pre-wired board containing four operational amplifiers and the switching electronics. No passive components are assembled. User can build up a four-pole active filter with freely setable frequency response.

AO7 Transformer output option. Adds a transformer behind the electronically balanced output stage.

AO8 Phantom power option. Installs either +15V or +48V Phantom power to one input channel. Replaces the low input impedance (200Ω or 150Ω). Soldering required.

AO9 Trigger output. Provides a trigger signal at the BNC output, indicating the zero transmission of the Sine signal. Factory retrofit only.

AO10 Digital option to analyze and generate AES/EBU signals with all sampling rates. SPDIF and optical TOS link in- & outputs on the rear panel. Automatically detects signal type. Generator can be locked to the Analyzer clock. Bit analysis and manipulation supported. High performance D/A converter allows to do all the analogue measurements upon the digital bit stream. Monitor facility supported.

AO11 GPIB parallel interface. Allows remote control of the A2 through an IEEE-488.2 interface. Including IEEE Remote Control Commands User Manual.

AO12 FFT option for A2 units with installed digital option AO10. Provides a single channel spectrum analysis of analog input signals. Display from 0Hz-5kHz or 0Hz-20kHz.

AO13 C-Message filter.

AO14 80kHz Lowpass filter.

AO15 AS04 PC-software update package for A2 units with installed AO1 option.

AO16 High-speed RS232 interface with AS04 PC-software. Allows remote control of the A2 through a serial interface. Including Windows-based AS04 software.

AO17 GPIB parallel interface & AS04 PC-software.

Accessories

AA10 Soft carrying bag. Perfectly protects the instrument on all sides. Allows in-bag operation of the instrument in all positions. Comes complete with shoulder strap.

AA12 Additional User Manual for the A2.

AA14 Additional protecting ABS plastic hard cover. Snaps onto the front panel of the instrument and protects it from water, dust and mechanical shocks.

AA15 Additional AS03 Software Manual.

AA16 Additional AO10 User Manual.

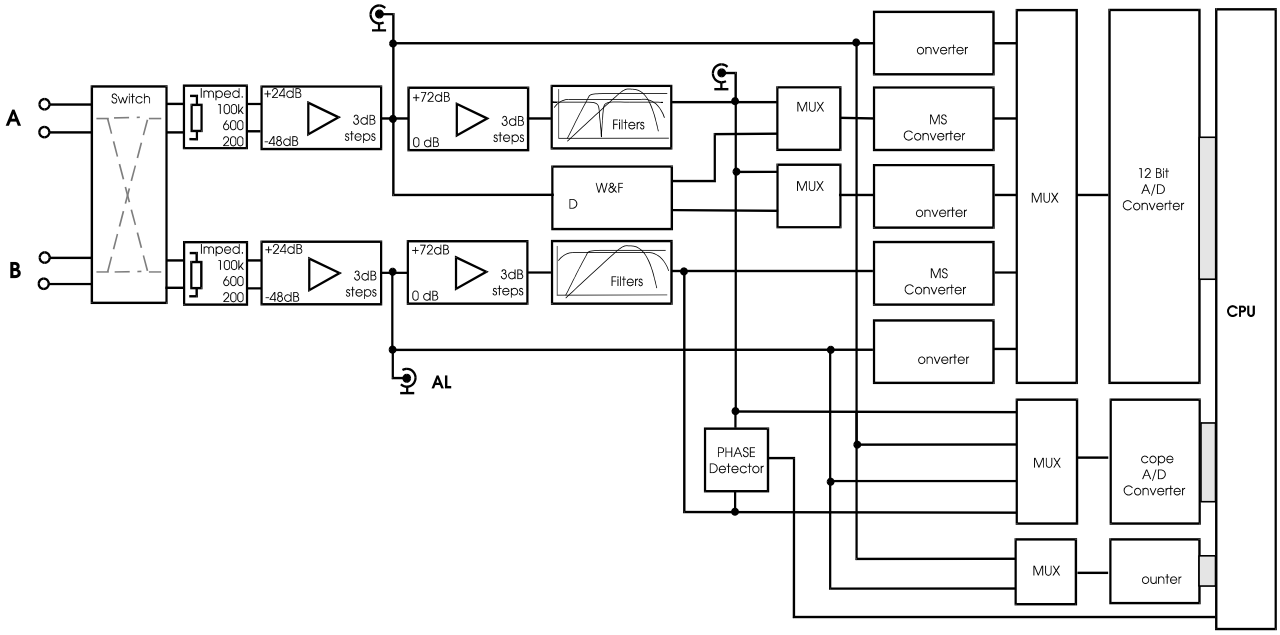
AA18 Additional IEEE Remote Control Commands User Manual.

AA22 Modem cable for remote control of the A2 under AS04 through a modem link.

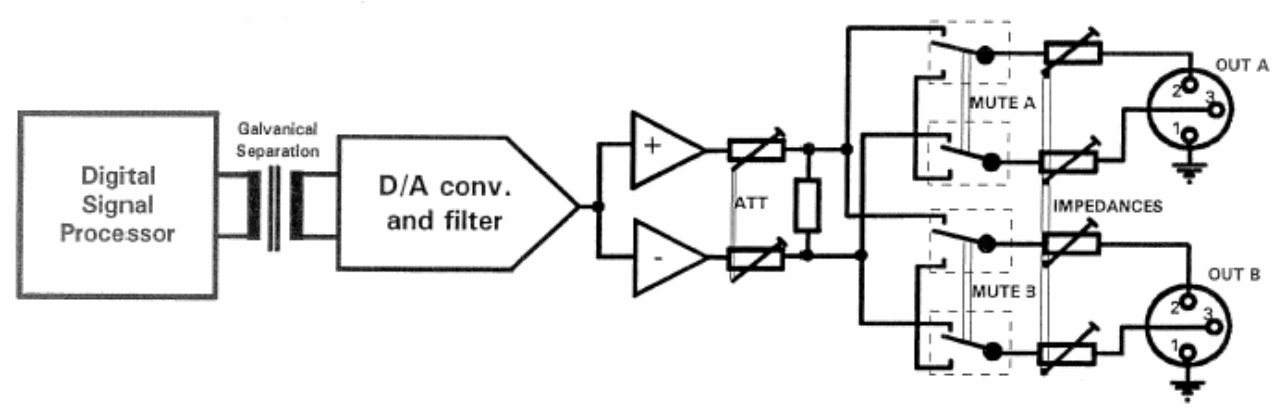
2. SYSTEM OVERVIEW

Functional Block Diagrams

Analyzer Block Diagram



Generator Block Diagram



Measurement Functions

LEVEL

The LEVEL function allows to perform absolute level measurements in true RMS[1] for either one or two channels simultaneously. The input signal is limited in bandwidth from 2Hz to 250kHz and presented, after passing the amplifiers / attenuators, to the true RMS detector. Several filters may be introduced into the path to further weight the signal.

Units	*V, dBV, dBu, dBm*
Reference	*1.000V for units V and dBV, 0.7746V for dBu, dBm units*
Available filters	*22Hz to 22kHz Audio-BP, 400Hz HP and any optional weighting filters.*
Rectifier	*True RMS*

L.REL (Level Relative)

The Level Relative function is an extension of the Level function, allowing to change the reference value for level measurements to any level that is present at the input connectors. To define the present input level as reference level, press the <SET REF> key.

Units	*dBr, *1, %*
Reference	*any absolute level value*
Available filters	*22Hz to 22kHz Audio-BP, 400Hz HP and any optional weighting filters.*
Rectifier	*True RMS*

THD + N (Total Harmonic Distortion + Noise)

Total Harmonic Distortion plus Noise (THD+N) is measured by inserting a notch filter into the signal path. This notch filter is tuned to the frequency of the main component (the fundamental frequency) of the incoming signal. The distortion signal is divided through the level of the total signal and the result is expressed in percent [%] or in [dB].

Units	*dB, %*
Reference	*total input signal*
Available filters	*4 pole auto-tuning notch filter with Q=5 in the range of 10Hz to 50kHz* *22Hz to 22kHz Audio-BP, 400Hz HP.*
Rectifiers	*True RMS*

IMD (Intermodulation Distortion)

Measurement of IMD are provided according to the DIN and SMPTE standard.
The generator produces a twin tone signal with low frequency of 60Hz or 250Hz and a high frequency (>4kHz) that can be swept. The non linear distortions of the DUT then produce new frequencies in the measurement signal. These distortion products are measured and set into relation of the total high frequency signal. The IMD value is again a ratio expressed in [dB] or in [%].

Units	*dB, %*
Reference	*total high frequency input signal*
Available filters	*none. All filters acc. to DIN & SMPTE standard are provided*
Rectifiers	*True RMS*

1 RMS= Root Mean Square. This is the energy equivalent value of the signal.

W & F (Wow & Flutter, Drift)

W&F measures the frequency modulation introduced by an irregular motion of the tape machines during recording and the reproduction process. Drift is measured by comparison of the measurement frequency with the crystal reference.

W&F can be measured according to NAB, JIS, IEC and BS either weighted or unweighted with 3.00kHz or 3.15kHz.

Units	*%*
Reference	*1% W&F = 1% Modulation of 3150Hz with 4Hz sine signal*
Available filters	*Weighting filters according to the above standards*
Rectifiers	*True RMS and Quasi Peak according to the standards*

NOISE

Measured according to the CCIR Recommendation 468-3 and 468-4 (DIN 45405), in either absolute or relative terms. Unweighted measurements under the Audio-Bandpass filter or the weighting filter defined in the above standard. The rectifier measures always Quasi-peak.

Units	*dBq, Vq*
Reference	*0.7746Vrms (WTD) = 0dBq*
Available filters	*Weighting filter according CCIR-468/4 and Audio BP*
Rectifiers	*Quasi Peak*

N.REL (Noise Relative)

Noise Rel. measures signals according to the Noise standards with a freely selectable reference that is entered by pressing the <SET REF> key.

Units	*dBr, *1, %*
Reference	*Any reference entered*
Available filters	*Weighting filter according CCIR-468/4 and Audio BP*
Rectifiers	*Quasi Peak*

CROSSTALK

Crosstalk measures the interaction of one channel into the other. Accomplished by feeding the one channel with a sine signal and measure frequency selective the other, muted channel. The ratio of the two inputs is the Crosstalk value. The frequency selective measurement is performed by inserting the narrow band filter into the analyzer path.

Units	*dB, *1, %*
Reference	*Input signal of the inactive channel*
Available filters	*4 pole narrow band filter with Q=5 and constant relative bandwidth*
Rectifiers	*True RMS*

L.SEL (Level Selective)

LEVEL SELECTIVE measures the RMS level of the signal presented at the active channel using the narrow band filter to analyze only a small frequency band only.

Units	*V, dBV, dBu, dBm*

Reference	*1V for Volts and dBV and 0.7746V for dBu*
Available filters	*4 pole narrowband filter with Q=5 and constant relative bandwidth*
Rectifiers	*True RMS*

PHASE

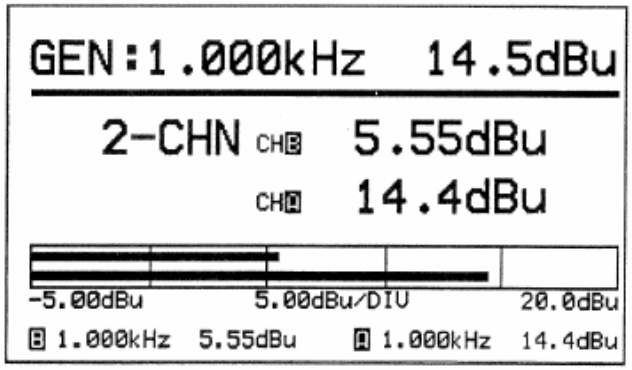
The function PHASE measures the phase shift of the active channel against the inactive channel (reference channel). The phase correlation of the two channels is displayed in the full range of ±180° degrees. The amplitude difference between the two input channels must not be more than 18dB.

Units	*° (Degrees) ±180°*
Reference	*0° is phase of the inactive channel*
Available filters	*-*
Rectifiers	*Phase detector*

DISPLAY MODE

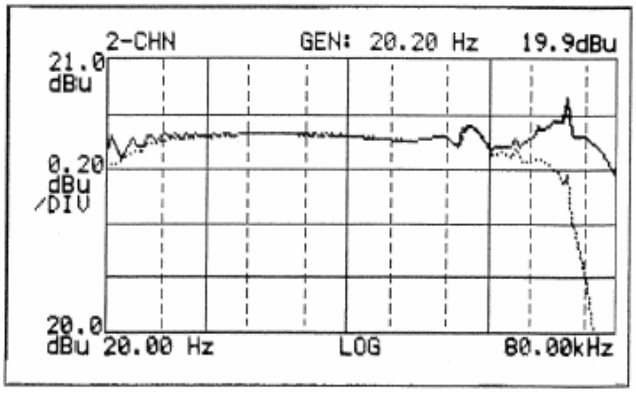
METER

This display provides all the necessary information and results of the selected measurement function and all related information which may further help to qualify your measurements. The top lines always contain the generator parameter, while the bottom line is reserved for the input parameter.



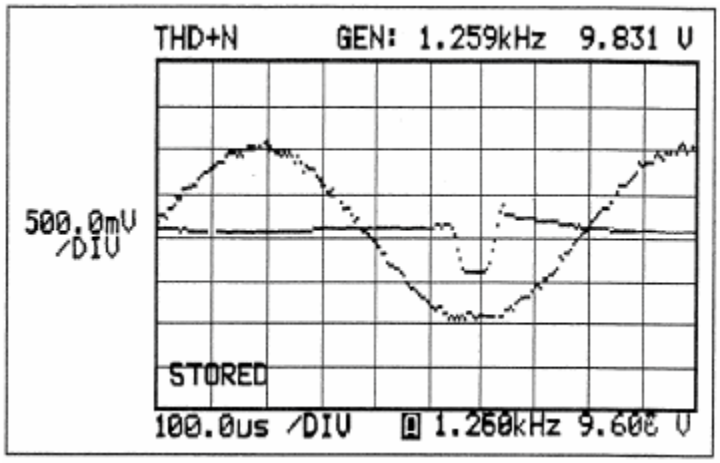
GRAPH

The graph display allows to display sweeps over frequency, amplitude or time. The X-axis scale can be selected manually while the Y-scaling is set either automatically or manually. The currently running parameter of the generator is shown on the first line of the GRAPH display, together with the selected measurement function.
The graph display can record up to six traces in the same graph and provides memory space to store up to four complete graphs.



SCOPE

The scope display mode offers a full Audio oscilloscope to analyze both input signals in the time domain. Both axes are scaled automatically, i.e. no manual scaling is available. Sampling rate is 2 Million samples per second. In the THD + N mode, the second trace shows the residual distortion signal. The scope function is blocked in the NOISE mode.



FILTER

Various filters are available in the different measurement functions of the A2. The filters are configured that, according to the selected measurement functions only filters are enabled which are defined in a standard. The weighting filters (WTD) change the characteristics too. WTD Level measurements are possible with one or two option filters installed.

400Hz Highpass Filter

The highpass is 3 pole filter providing the low frequency corner at 400Hz, rejecting lower frequencies with a steepness of 18dB/Octave, resulting in 60dB/decade.
The highpass filter can be activated in measurement function 2-CH, LEVEL, L-REL, THD+N, XTALK and L-SEL, but not in IMD, W&F, NOISE, N-REL and PHASE.

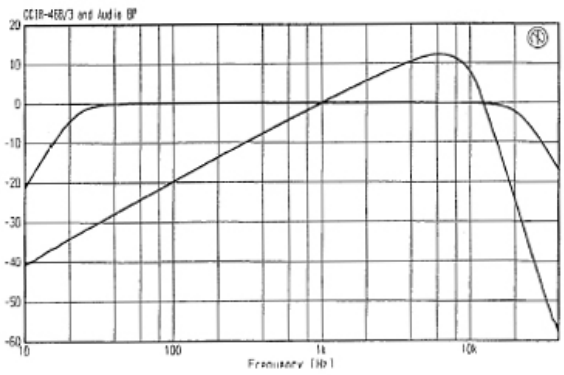
Audio Bandpass Filter

DIN audio bandpass filter with corner frequencies at 22.4Hz and 22.4kHz according to the DIN 45405 and CCIR 468 specifications. The filter consists of a 3-pole highpass and a 3-pole lowpass filter. This results to a steepness of 18dB/octave or 60dB/decade on both ends of the filter. The bandpass filter is available in measurement functions 2-CH, LEVEL, L-REL, THD+N, XTALK, L-SEL, NOISE and N-REL but not in IMD, W&F and PHASE.

Weighting filters

Different weighting filters for W&F and NOISE according to the different standards. Noise filter is according the CCIR-468/4 standard.

W&F filters according to DIN 45507 and JIS C 5551. The A2 selects automatically the matching filter for the actual measurement function and standard.



SWEEP Definitions

Sweeps can be performed with minimum operational effort in almost all measurement functions.

DO SWEEP / STOP

Starts the sweep with the set parameters. Activation of DoSweep automatically activates the display mode GRPH. A running sweep can be stopped by the same key. Autostart features are supported in the external synchronized sweep mode.

Resolution

Defines the number of frequency steps for a sweep between the start and stop value. For both resolutions, LOW and HIGH, the number of measurement points can be individually programmed by activation of the resolution menu.

Default Setup	Low:	30	steps
	High:	200	steps

START & STOP Value

Copies the actual oscillator frequency or level as the Start- or Stop-frequency / Level for a sweep. If Amplitude-sweep is selected and active (see Sweep Mode) the generator amplitude is read for the amplitude sweep.

SWEEP MODE

Select internal or external sweeps and internal or external filter tracking for THD and Level selective or choose the sweep type Amplitude, Time or Table.

Select sweep mode via the double click soft menu.

FREQ: Internal and external frequency sweeps. Internal means that the generator frequency steps through from the start to the stop frequency. External means that a sweep is started automatically by a 315Hz or 1kHz signal tone that is applied longer than 3 seconds or manually by pressing the DO SWEEP key. The incoming frequency is measured and the recorded value is taken for the x-axis position.

TAPE: Tape Frequency Sweep Mode is used especially for creating test tapes. Each frequency step lasts a fixed time (0,5 up to 10 sec). External mode does not differ from external frequency sweeps.

F-TAB: Frequency Table Sweep is a frequency sweep that steps through predefined values that are downloaded via the RS232 interface. A second level parameter can be optionally specified. Additional keywords are accepted. Please refer to Users manual for details.

AMP: Amplitude Sweep Mode. The amplitude is stepped through from start to stop amplitude or in external mode the incoming amplitude on the main channel is measured. The entire level range of the oscillator can be used.

TIME: Timesweep. The measured value is displayed over the time. Duration last from seconds, minutes, hours (up to 3 days)

GEN SIGNAL

~ / ALT (Sine / Alternate Signals)

The alternate signals soft-menu can be opened by double-clicking the < ~ ALT > key. There are Square 50/50% or 40/60% duty cycle, different IMD test signals, Warbled sine, White & Pink Noise etc.

PRINT

Prints the measurement results on different printers via a Centronics type interface.

- In the Meter mode the actually valid measurement result is printed.
- In the Graph mode the curves of the last sweeps are printed.
- In the Scope mode the last scope screen is printed.

For selecting your printer type, double-click on the <PRINT> key to open the soft-menu.

INPUT

Fully balanced input with 200Ω, 600Ω or 100kΩ input resistance. For the US, the 200Ω may be replaced by 150Ω, which is achieved by paralleling the 200Ω and the 600Ω impedance. Optionally, the lowest impedance my be replaced by Phantom power.

PHANTOM

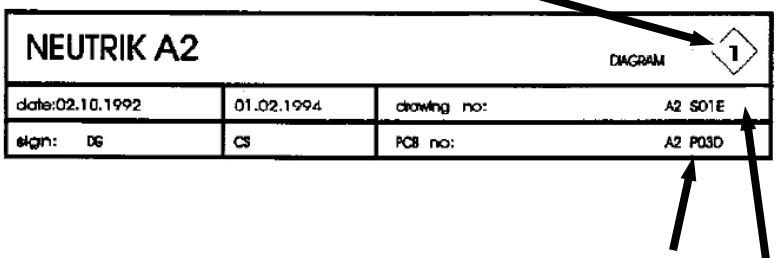
Optional it is possible to install a Phantom Power supply of 15V or 48V via 1kOhm instead of the 200Ohm input resistance. Can be installed for each channel individually.

OUTPUT

Floating, electronically balanced power amplifier with less than 15Ω source impedance. 200Ω or 600Ω are also selectable. Output voltages from as low as 10µV up to 24.49V (30dBu) in the frequency range from 10Hz to 100kHz are selectable.

3. CIRCUIT DESCRIPTION

The following chapter describes the circuitry where necessary and explains the functions of the different boards. The description refers to a certain schematic diagram that can be found in the appendix. Each schematic diagram is marked in the bottom right corner of the diagram with a number like



The related PCB number can also be found in the box under PCB no:

The title of the schematic diagram is always ,listed in the bottom left corner of each drawing.
The coordinate grid from A to K in horizontal direction and the number 1 to 8 in vertical direction shall help to find certain areas in the diagram by these coordinates.

Below is an example of the diagram title following on the next page.

INPUT AMPLIFIER **Diagram 1**

This is the schematic diagram title that is found in the lower left corner of the diagram

This is the schematic diagram number

Input Amplifier Diagram 1

Main Functions

- Input selection between channel A and B
- Selectable input impedance
- Differential input amplifier / attenuator
- Over-voltage protection circuit
- Option: Phantom power supply instead of the 200Ω (150Ω) input impedance.

Description

> ***Series >400:*** *Different reference designators or components for instruments with SNo. Below 400 are shown in italic characters.*

Input selection between channel A and B is possible with REL503 and 504.
During autocalibration the inputs are disconnected from the XLR connectors and the generator-signal is looped through directly from output A via REL901 and REL902 (See diagram 14) to the inputs.

Input impedances are selected with REL501 and 502. The input impedance can be switched between 100kΩ, 600Ω and 200Ω (150Ω). The 200Ω impedance (two 100Ω resistors in series) could be replaced with other values.

The differential input amplifier/attenuator (REL509-512 *or 511*) and REL507+508 sets the level in 12dB steps to a value of 750mV to 3V at pin PREPGA (for input signals >10mV).

The PGA (programmable gain amp.) IC527 & 532 is used for a level fine adjustment (3dB steps).

The overvoltage protection circuitry consists of PTC resistors R567 & R566 and some protection diodes (D508-D528).
F501 / F502 and D504 / D505 are used for an additional protection of the resistors R509, R511 and R512 (selectable input impedances).

Optionally it is possible to assemble a Phantom power supply for microphones. This modification replaces the low input impedance. For installation, please refer to chapter *4. Maintenance - Phantom Power Supply*.

Notch Filter Diagram 2

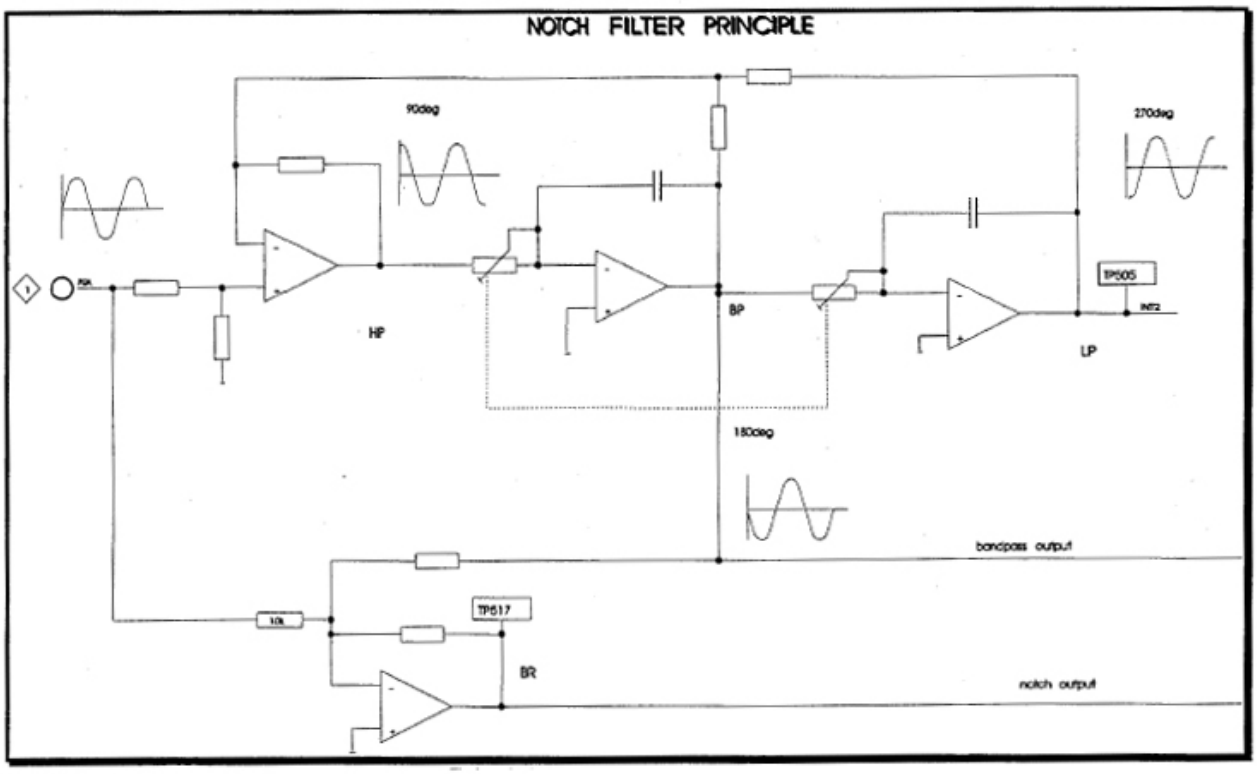
Main Functions

- Tunable bandpass filter
- Rejection (by subtraction) of the fundamental frequency

Description

The tunable state variable filter (IC510-514) has a selectable center frequency adjusted by a dual D/A converter that is used as a stereo potentiometer (IC518) and the switchable capacitors C534-542 and C532-540.

The signal from the bandpass output of this filter (IC516/6) is subtracted from the input signal (PGA) via IC521, 525, 526 and 530 building the notch.



Principle diagram 1 Notch filter

This filter type is built of simple building blocks (amplifier, summer and integrator)

The transfer functions at various points is different: High pass filter characteristics is available at the output of the summing amplifier, bandpass characteristics after the first integrator, and the low pass characteristics at the output of the second integrator.

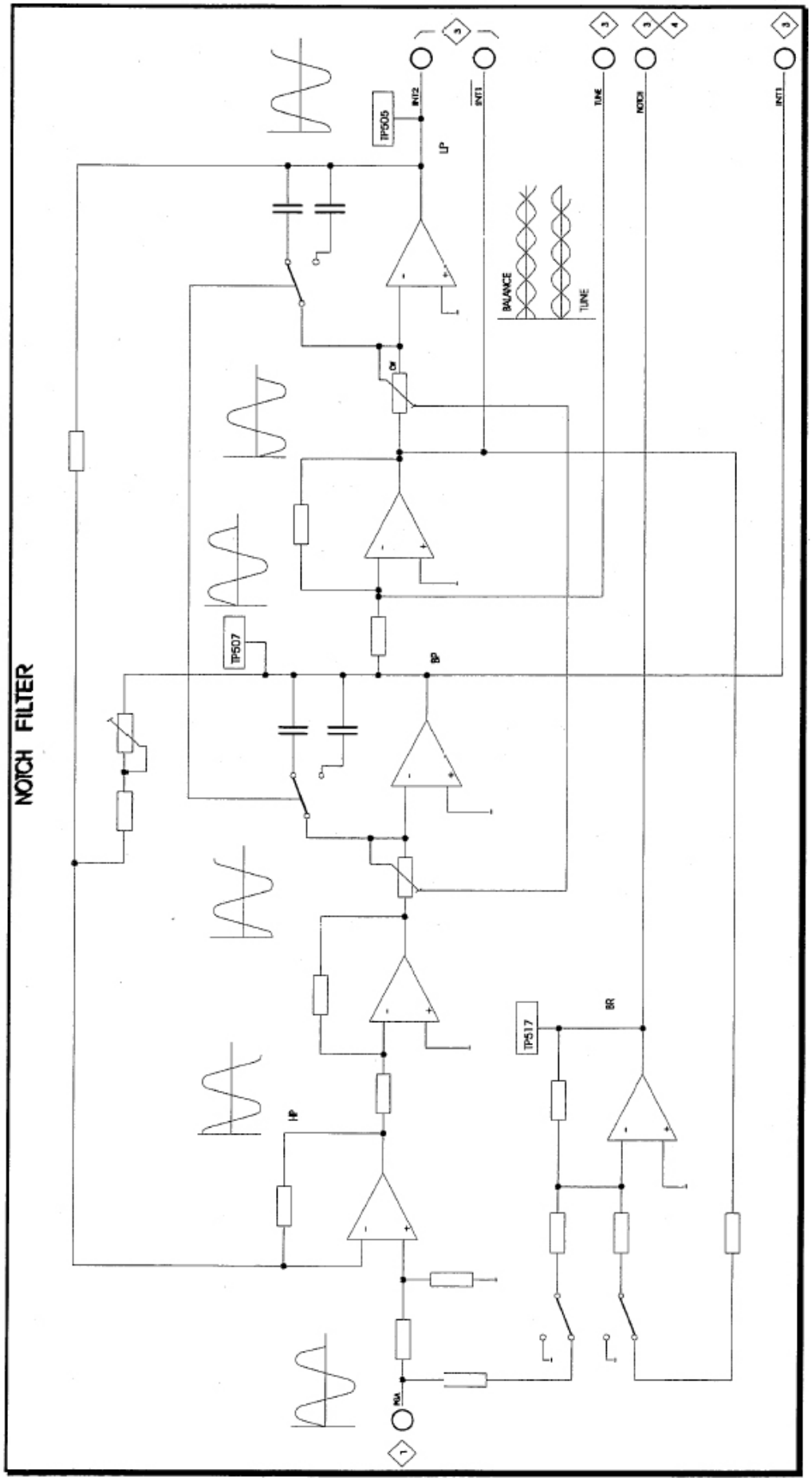
Notch filtering can be achieved by simply subtracting the bandpass filtered signal from the incoming signal.

Circuit description (refer principle diagram ***Notch filter***)
The input signal passes the summing amplifier, the first and second integrator (low pass output). The two R/C (C in feedback-loop) combinations are building a 2nd order lowpass. The feedback resistor from the LP output to the summing-amp. sets the gain for low frequencies. The corner frequency is determined by the R and C values of the integrators.
The LP output is phase reversed by the two integrators. This signal added to the input signal leads to the high pass frequency characteristics behind the summing amplifier. (All frequencies except low will pass through)

A narrow bandpass filter can be built by setting LP- and HP corner frequency to the same value.

The potentiometer RT504 adjusts the filter-gain. Adjusting the filtergain is necessary to equal the level of the bandpass-signal and the input signal (done under software control during adjustment procedure - refer chapter *6. Adjustments*

To fine-tune filter-frequency and -balance a signal from the notch control circuit (TUNE) is looped back to add either an in-phase (0°) or out-phase (180°) component to the filter signal.
A 90° out of phase (90° or 270°) signal changes the phase of the signal in the filter.
An in-phase signal (0 or 180°) changes the frequency.



Principle diagram 2: Detailed notch filter

Notch Filter Control Diagram 3

Main Functions

- Control of the amplitude and phase of the state variable filter. Maximize signal rejection.

Description

This circuitry is active in measurement functions THD+N. The circuitry fine-tunes the filter for maximum rejection by adding a signal to the state variable filter to adjust phase (±90°) and amplitude (0° or 180°) to an optimum.

Explanation

The residual signal from the notch filter output is multiplied with the two signals INT1 (in-phase) and INT2 (out-phase). The amount of in-phase and out-of phase components of the residual notch signal shows the quality of the fine tuning (refer also to *Principle diagram 3 Notch control*).

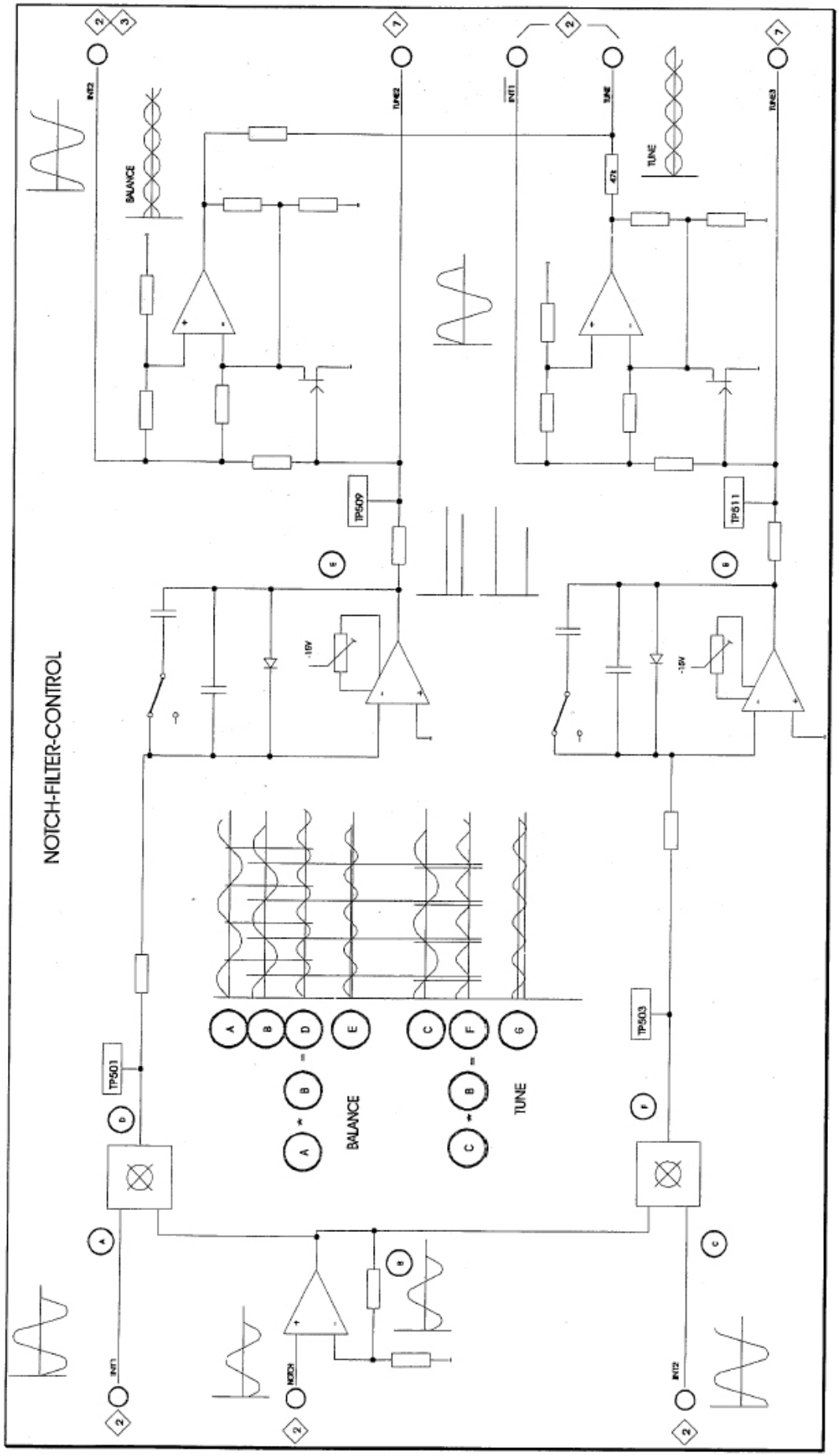
The product of two signals with same frequency but different phase (e.g. notch-residual * INT) is a signal with twice the signal frequency and a DC component. The DC voltage is directly correlating with the phase-shift between the two signals.

The "in phase component" of the notch filter's residual signal represents a balance error; the "out of phase" (±90°) component represents an error due to imperfect tuning of the notch filter.

The following integrators control the amount of signal that is looped back to the state-variable-filter by feeding back more or less of in- and/or out-of-phase signals to it.

Usually, when tuning to a new frequency, the notch signal has both, a balance and a tuning error, which will be eliminated by the control circuitry.

A properly tuned notch filter has a very small residual signal and almost no fundamental in the signal - no in-phase nor out of phase signal-components.



Principle diagram 3 Notch control

Measurement Amplifier, Filters — Diagram 4

Main Functions

- Measurement Amplifier
- Filters

Description

> ***Series <400:*** *Different reference designators or components for instruments with SNo. below 400 are shown in italic characters.*

The signal from input PGA or from the notch output is amplified in 12dB steps from 0 to 72dB (IC524, IC632, IC529 and IC535). The average rectifier (IC523) measures the amplitude of the audio-filter-signal.

FILTERS:	***HP AND LP FILTERS (IC635 TO IC638 AND IC642)***
22kHz LP:	Circuitry around IC540/D
250kHz LP:	Circuitry around IC540/C
10Hz HP:	Circuitry around IC541/C *(R656)*
22Hz HP:	Circuitry around IC541/B *(IC548/A)*
400Hz HP:	Circuitry around IC541/D *(IC548/B)*
WTD filter CCIR 468:	IC537/A..549/B

Wow and Flutter Test Circuit — Diagram 5

Main Functions

- Bandpass filters input signal from input PGA
- Automatic Gain Control as input for PLL
- PLL (Phase Locked Loop)
- Weighting filters
- Programmable Gain Amplifier
- Quasi-peak detector and time weighting

Description

IC542 and 544 are used for band limiting the input signal. IC544 and FET T522 form a automatic gaincontrol to feed the signal with constant amplitude the PLL input (IC545 pin 14). The PLL detects the frequency variations and generates a corresponding output signal (pin 10). In other words it demodulates the frequency modulated signal. The resulting signal is filtered IC555/A..IC553/B (weighting filters NAB or IEC selected with the analog switch), amplified (PGA IC560/B and IC563) and peak rectified (IC553/C..562/B).
The quasi-peak rectifier has a short rise and long fall-time (according to NAB/IEC).

Rectifiers Diagram 6

Main Functions

- Multiplexer and comparator for frequency counter
- RMS detector for the input RMS value
- RMS detector for the output RMS value = measured value
- Quasipeak detector according to CCIR468
- A/D input multiplexer
- Monitor speaker "power amplifier" (IC572/A, T528, T530)
- Phase correction (0/180deg) for monitor signal (IC552/A, IC572/B)

Description

The signal source for the frequency counter is selected with the multiplexer (IC551). The following comparator (IC558 and IC557) has a 50% hysteresis (half of the signal of the positive halfwave peak-detector with diode D551 is used as reference input for comparator IC557 - similar for D552 and neg. Halfwave).

In scope mode this comparator circuit is used as trigger source. To ensure a zero crossing trigger start the positive hysteresis is set to 0V (analog switch IC552/D) in scope mode.

Maximum input voltage of the RMS detectors (IC561 and 559) is 1.00 Vrms. lowpass IC568/A and /B are used for ripple rejection of the RMS detector output-signal (DC).

The CCIR Quasipeak-detector (IC569/D..564/A) has a characteristic corresponding to CCIR 468 (defined rise and fall times).

IC571 is used to select the input signal of the A/D converter (located at uP/generator board (diagram 16 A7).

Analyzer Interface Diagram 7

Main Functions

- Interface between CPU and analyzer hardware.

Description

The use of bi-stable relays requires capacitors between the latch output and the relays coil to form negative and positive pulses to toggle the relays. After initialization the relays are in OFF position with register outputs HIGH.

The buffered register outputs with a comparator(IC507/IC513) control the FET's of the notchfilter (register output low --> comparator output -15V: --> FET off).

Comparators (IC577 and 578 are used for fast over- and under-range detection.
An over- or underrange-detection sets a flip-flop in the GAL IC574 (reset via RES_RNGD).

IMD and DFD Circuits Diagram 8

Main Functions

- Input Signal HP filtering
- Demodulation
- Signal low pass filtering
- Signal integration

Description

The IMD board can be activated via the relay REL851.

- For IMD measurements the signal is high pass filtered at the inputs with (IC861, 859, 858) to eliminate the 60Hz or 250Hz carrier and amplitude demodulated (IC857). The output signal of IC857 represents the signal reference amplitude (IC851) and AC coupled as well the residual IMD signal. This IMD residual signal is low pass filtered (IC854 and 856) to eliminate the high frequency carrier and to get the pure Intermodulation distortion with a frequency of 60 or 250Hz.

SERIES >400 OR UPGRADED UNITS: *(Board versions A2 P08E and up) For IMD 1:1 a special amplitude control circuitry is added (IC862). If the DC reference value is too small an additional amplifier is added (IC862/B).*

2nd Channel Input Amplifier Diagram 9

Main Functions

- Input selection between Channel A and B
- Switchable input resistance
- Differential input amplifier
- Protection circuit
- Pre Gain Amplifier
- Option: Phantom power supply instead of the 200Ohm input resistance.

Description

> ***Series <400:*** *Different reference designators or components for instruments with SNo. below 400 are shown in italic characters.*

Input selection between channel A and B is possible with REL121 and REL122 *(REL 003)*.

During autocalibration the inputs are disconnected from the XLR connectors and the generator-signal is looped through directly from output A via REL901 and REL902 (See diagram 14) to the inputs.

Input impedances are selected with REL123 and REL124 *(REL 001 / REL002)*. The input impedance can be switched between 100kΩ, 600Ω and 200Ω (150Ω). The 200Ω impedance (two 100Ω resistors in series) could be replaced with other values.

The differential input amplifier/attenuator REL127-130 *(REL008-011)* and REL125/126 *(Rel006/007)* sets the level in 12dB steps to a value of 750mV to 3V at pin PREPGA_P (for input signals >10mV).

The PGA (programmable gain amp.) IC124+125 *(IC023/024)* is used for a level fine adjustment (3dB steps).

The overvoltage protection circuitry consists of PTC resistors R131+R132 *(R058 & R059)* and some protection diodes D122...D129 *(D014...D026)*.
F001 / F002 and D008 / D009 are used for an additional protection of the resistors R047, R044 and R046 (selectable input impedances).

Optionally it is possible to assemble a Phantom power supply for microphones. This modification replaces the low input impedance. For installation, please refer to chapter *4. Maintenance - Phantom Power Supply*.

2nd Channel Measurement Amp. & Filters Diagram 10

Main Functions

- Measurement Amplifier
- Filters

Description

> ***Series <400:*** *Different reference designators or components for instruments with SNo. below 400 are shown in italic characters.*

The signal from input PGA is amplified in 12dB steps from 0 to 72dB (IC127, 128 and 136) *(IC002,003 & 004).* The average rectifier (AVG) measures the amplitude of the audio-filter input signal.

FILTERS:	***HP AND LP FILTERS (IC131 TO IC135)***
22kHz LP:	R177, 179, 184, 185, C153, 159, 163 *(R013, 016, 028, 029, C015, 021, 024)*
250kHz LP:	R180, 181, 183, C154, 155, 158 *(R014 - R018, R020, C016, C017, C020, C022)*
10Hz HP:	R188 *(R032)*
22Hz HP:	R162, 193, 195, C164, 167, 168 *(R073, 084, 087, C063, 067, 068)*
400Hz HP:	R186, 189, 190, 191, C160, 161, 162 *(R033, 037, 039, C026, 027, 028*

Phase Circuitry — Diagram 11

Main Functions

- Phase to Voltage Conversion

Description

> ***Series <400:*** *Different reference designators or components for instruments with SNo. below 400 are shown in italic characters.*

The signal from both PREPGA amplifiers are "EXOR“ed and the relation between high pulse and low time is measured and converted into an analog signal for the A/D converter.

IC001 *(IC031)* is a preamplifier (faster zero transitions).

IC002 and 010 *(IC028 and 038)* condition the signal for logic devices. For very fast signals there is a very small hysteresis set with C003 and C018 *(C125 and 147)*. To optimize precision for lower frequent signals, the comparator is - if once toggled - blocked until the input signal has reached half of its maximum amplitude. This is achieved with IC003...005 *(IC029...033)* and IC011...013 *(IC039...042)* and IC008 *(IC036).*

The EXOR signal carries no sign-information of the phase-value. The circuitry around IC006 and 009 *(IC034 and 037)* detects of the leading signal transition - to define the sign.

IC014/A *(IC017/A)* integrates the EXOR signal, and IC014/B *(IC017/B)* is used as a switchable amplifier (*1 or *4 for small phase differences) to get a better resolution for small signals.

2nd Channel Rectifiers Diagram 12

Main Functions

- RMS detector for the input RMS value (IC139, IC140/A) *(IC012, 014/A)*
- RMS detector for the output RMS value = measured value (IC138, IC140/B) *(IC013, 014/B)*
- A/D input multiplexer (IC141, IC142) *(IC026, 027)*
-

> ***Series <400:*** *Different reference designators or components for instruments with SNo. below 400 are shown in italic characters.*

Description

The two RMS detectors are similar to the ones used in Diagram 6

2nd Channel Analyzer Interface Diagram 13

Main Functions

- Interface between CPU and analyzer hardware.

Description

The use of bi-stable relays requires capacitors between the latch output and relay coils to form negative and positive pulses to toggle the relays. After initialization the relays are in OFF position with register output HIGH.

Keyboard, Input and Output Diagram 14

Main Functions

- Keyboard encoder
- Softwheel direction detection
- LED control
- Analyzer input selector (internal / external loop)
- Monitor speaker level control

Description

The 20 key keyboard encoder IC901 is expanded to a 28 key encoder with diodes D910 and D911 and two inputs of the latch IC904.

IC904 is as well used for detection of the direction of a softwheel turn. When a pulse is detected from the CTC the software checks if the corresponding input of the buffer is high or low to decide if the softwheel turns right or left.

The latches IC903 and IC902 control the LED and the input selection (loop) relays.

L901 is the DC/AC converter ($5V_{DC}$ into $60V_{rms}$) providing the supply for the backlight illumination.

With REL901 & REL902 input B can be connected directly to the generator-output during auto-calibration.

CPU, Memory, Display Controller Diagram 15

Main Functions

- Microprocessor hardware
- Display controller
- Clock generator
- Parallel input/output
- Printer interface
- EEPROM

Description

The Z80 (IC392) microprocessor controls the complete test instrument and manages the system. Status and results are stored in nonvolatile RAM (IC399) while the firmware program is stored in ROM (IC398). The PIO (IC406 parallel input/output) is used the printer the interface (IC404) and to communicate with the EEPROM (IC408). The address decoding circuitry is arranged in two GALs (IC387/389). More I/O and decoding logic can be found on diagram 16.

The display controller (IC396) of the LCD panel has its own RAM (IC401).

The clock is generated with IC394 and divided with and IC402 (CLK=4MHz, CLK8=8MHz, CLK2=2MHz, CLK1=1MHz).

I/O Circuitry & A/D Conversion — Diagram 16

Main Functions

- Detection of the softwheel-movements
- Frequency counter
- HW timer
- Control of the communication with the generator, the keyboard and the analyzer
- A/D conversion for measurements
- 20MHz 8bit A/D conversion for scope

Description

The first CTC (IC416) is for frequency counting. IC414 is the additional logic for the gating the frequency counter. The second CTC (IC411) detects and measures the softwheel movements and acts as a pulse counter. The CTC (IC417) and divider (IC413) are used to derive the desired clock for the fast A/D converter.

The A/D Converter (IC378) is physically located on the µP/generator board but drawn on this diagram for more convenience.

The bus communication registers are build around IC391 and IC388. Address decoding for the SIO, PIO and the keyboard is done by IC427.

Power supply for the backlight of the LCD panel is switched with T366.

IC397 is the 20MHz 8bit A/D converter for scope measurements The results are written to the FIFO memory (IC409).

DSP and D/A Converter — Diagram 17

Main Functions

- DSP (Digital Signal Processor) signal generation
- DSP Signal Latch
- Shift Register
- DA Converter
- Current voltage converter
- Latch for Dsp and filter control

Description

The DSP (IC379) gets the executable program via download from the Z80. It generates the main timebase for all further signal processing (output SAMPLE). This timebase is 520.828kHz for sine and square and 260.414kHz for all other signal wave forms. If this signal is active the DSP operates properly.

The SAMPLE forces the GAL (IC382) to produce a DSP interrupt on every sample (IRQB) with a fixed delay. The DSP loads the next sample into the DSP data latch (IC377, 374, 376) after receiving IRQB.

The GAL also generates a signal to load the data from there into the shift register (IC369, 371, 372, 373) and to clock it out with the signal B_CLK. The Bitclock runs continuously at a frequency 32 times the SAMPLE-frequency.

The D/A Converter (IC363) gets its Data through the opto-couplers (IC366, 367, 368), to keep it electrically isolated on the generator float potential. The D/A converter starts its conversion also with the SAMPLE signal.

The Potentiometers (RT351, 353) near the D/A Converter allow optimization of the generator THD and IMD data.

The potentiometer (RT355) at the current-voltage converter (IC364) is to adjust the maximum generator output amplitude.

Reconstruction Low Pass Filter — Diagram 18

Main Functions

- Filtering the D/A converters output

Description

The filter consists of two 7 pole FDNR filters. The first one (IC358, 357 and 354) is fixed to 105kHz. Operational amplifier (IC356) is for decoupling the two filters. The second filter can be set to different frequencies.

Find below a list for the frequency ranges in which the capacitors are in use. There are five capacitors of the same value. The 470p capacitors are not switch (always active).

Frequency Range	470p	820p	1n8	5n6
10 Hz - 6,5 kHz	on	on	on	on
6,5 kHz - 8,0 kHz	on	on	off	on
8,0 kHz - 10,5 kHz	on	off	off	on
10,5 kHz - 14,7 kHz	on	on	on	off
14,7 kHz - 21 kHz	on	off	on	off
21 kHz - 36 kHz	on	on	off	off
36 kHz - 100 kHz	on	off	off	off

Output Power Amplifier Diagram 19

Main Functions

- Power amplifier
- 12dB amplitude gain switching

Description

The Power amplifier consists of two inverting operational amplifiers. The first one has a switchable gain. The second has a gain of one.

The relay REL216 at the input sets the gain of the first amplifier to either 7.6dB or -4.4dB (difference of 12dB). The potentiometer RT201 is for adjusting the amplifier to the primary impedance of the transformer (used for trafo option only).

The input stage of the power-operational amplifier is built of a differential amplifier (T222, 224, 221, 223) with current mirroring. The T229 and T228 are constant current sources. T211, 212, 213 and 214 is for a high gain. The four diodes (D231, 232, 233, 234) are for current limitation. The transistors T203 and 204 form the output current amplifier.

The integrator circuitry around IC222 is required with transformer option installed, to compensate the drift around the zero point (active only if jumper J210 to pin 1-2).

The second OP operates similarly but gets its input signal from first Op-Amp.
NOTE: Make sure that the first stage works correct before checking the second.

Output Circuitry Diagram 20

Main Functions

- Attenuators -24dB or -48dB
- Individual mute of channel A and B
- Selectable output impedances
- Generator read-back measurement circuit
- Hardware version read-in circuitry

Description

The attenuators 24dB (REL211) and 48dB (REL212) are simple resistor networks for voltage dividing. For installed transformer option, the dividers are connected to the center of the transformer outputs, otherwise to the generator ground. Remove R281, 282, 284 and 285 and the bridge R283 for installed transformer option.

The Mute relays (REL201 and 203) switches 12Ω resistors to the outputs providing a constant output impedance

The generator readback circuitry has a dynamic range of 24dB. The amplifier gains are locked to the attenuators of the generator output. The first two differential input amplifiers can be switched between +30 and -18dB. The second ones are switched as inverting amplifiers which can be switched between +32dB and +8dB.

The hardware version readback is a simple buffer (IC209) and a hardwired 2-or 3bit information. Three are for the analyzer and three for the generator hardware version. The remaining two are hardwired directly on the motherboard (P01).

Power Supply Diagram 21

Main Functions

- producing +5V for the digital circuitry
- producing +5V unregulated for the EL foil
- producing +5V for the Led driving
- generating reset signal during power up (IC221)
- producing ± 15 V for analyzer
- producing ± 15 V for generator circuitry
- producing ± 23 V for generator circuitry
- producing ± 23 V unregulated for power amplifier circuitry

Description

The digital ground (/) and the analog ground (-) of the analyzer are connected directly at the motherboard. The DSP section of the generator is referenced to digital ground (/).
The ground (U) of the generator DAC and power amplifiers is decoupled via optocouplers and special separate trafo sections. There is no connection between (U) ground of the generator output stage and the analyzer ground (/ or -)!

4. MAINTENANCE

Disassembly of the Instrument

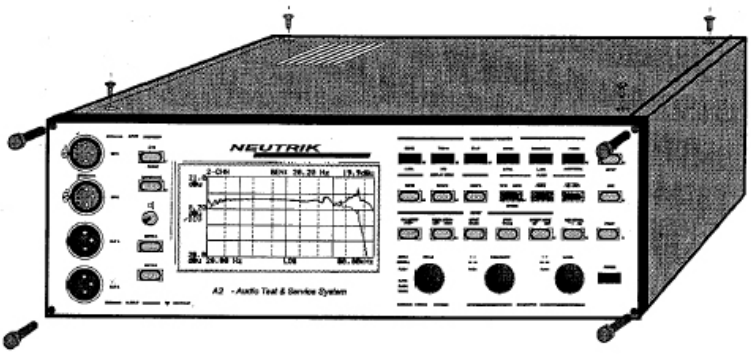
Chassis Removal

Disconnect the A2 from mains power.

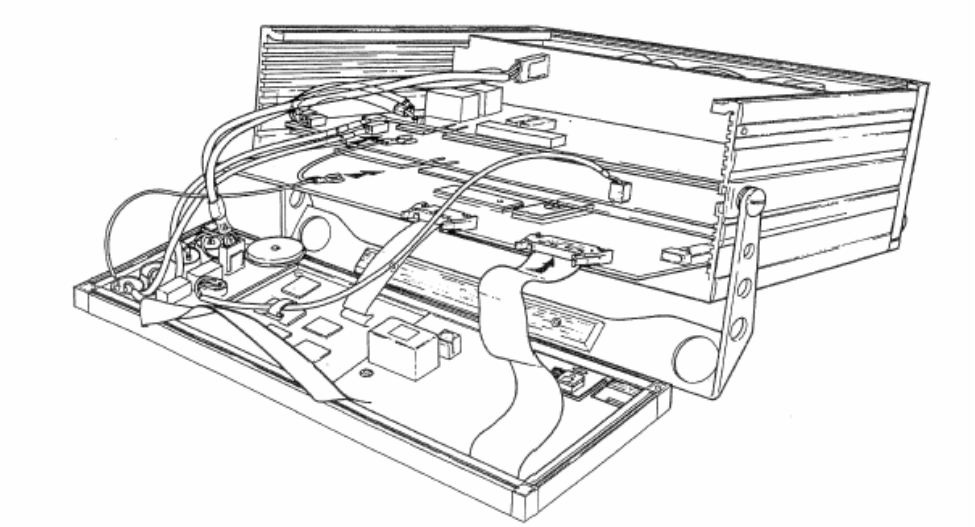
Remove the four hex screws on the top cover of the A2 and lift away the top cover. Be careful not to loose the screws.

WARNING! **Haz**ardous voltages exists inside the A2 whenever it is connected to the mains voltage. Do not touch or probe any component around the power entry module or the mains transformer, unless power cord is unplugged.

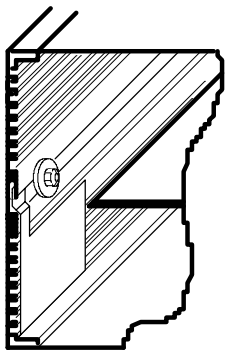
Remove the four hex screws in the corners of the A2 front panel. The screws are secured in the whole not to get lost when disassembled. Place then the front-panel onto the desk. The handle brought to the front position may help to keep the panel in its position.



Carefully disconnect all cables leading from the front panel to the PCB and keep a note which cable leads to what connector.

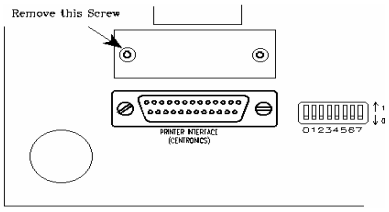


Remove the fixing plates mounted to both side walls (Only with units with serial numbers <400). They fix the PCB's in its positions. Newer models do have an additional PVC block that is to remove before proceeding (one screw at bottom plate).



Mark the position where the upper PCB is inserted with a pen and then gently pull out the upper PCB (Analyzer PCB) including the mounted boards (ALT-channel, digital option etc.).

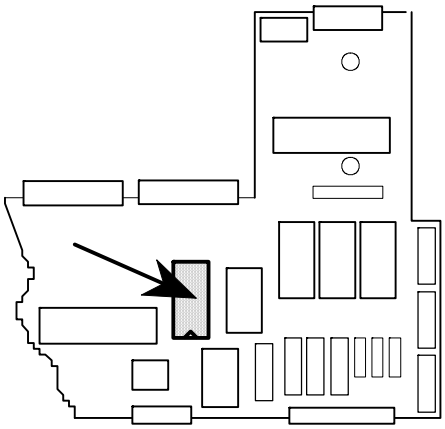
To disassemble the larger lower PCB, the µP/Gen board, remove the hex screw on the back side providing mechanical fixation of the PCB.



Change Firmware (S/N < 400)

To change the firmware of the A2, that is stored in an EPROM of the size 27C1001, please proceed the following steps.

- Remove the labeled EPROM from the lower PCB in the position shown below. Keep a note in which direction it was inserted.
- Insert the EPROM with the new software in the same way as the old one was in. Be sure that no leg of the EPROM is bent.
- Carefully insert the analyzer PCB in the previously marked position.
- Mount the side wall fixing blades for the bottom PCB.



- Assemble the instrument in the opposite order as illustrated in disassembly.

- Connect the A2 with mains power. The A2 starts calibration itself automatically in case of requiring a new calibration.

Change Firmware (S/N > 400)

To change the firmware of the A2, that is stored in an EPROM of the size 27C1001, please proceed the following steps.

- The EPROM is mounted on the solder side of the lowest PCB and can be directly accessed from the bottom. Remove the bottom cover of the instrument the same way as the top cover has been removed. It is not necessary to completely disassembly the instruments; removing only the bottom cover sufficient. Some older models do have an additional cross recessed head screw at the front of the base plate that fixes a PVC holdback block, remove that too. Be careful with the cables leading to the speaker.
- Remove the labeled EPROM from the PCB. Keep a note in which direction it was inserted. Don't mind of the direction of the label, but of the small notch on the shorter side of the EPROM.
- Insert the EPROM with the new software in the same way as the old one was in. Be sure that no leg of the EPROM is bent!
- Reassemble the bottom plate and fix the four hex screws.
- Connect the A2 with mains power. The A2 starts calibration itself automatically if necessary.

RS232 Interface Adapter - AO1 / AO16

Installing the Serial Interface

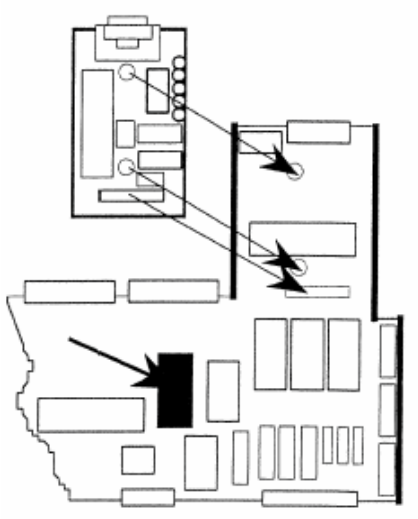
The serial interface retrofit kit for the A2 consists of

1 Add-on PCB to install
1 Installation instruction
1 AS03 / AS04 Software package to control the A2 by a PC
1 Software manual for AS03 / AS04

Disassemble the instrument as described in chapter *Disassembly of the Instrument*.

Take the lowest PCB, i.e. the µP/Gen PCB if front of you.

Gently insert the add-on PCB in the position shown below. Use the screws to fix the PCB in the prepared holes.



Carefully return the µP/Gen. PCB with the mounted Add-on board in the previously marked position. Watch the rod of the mains switch. Lead the 25 way Sub-D connector with your fingers into the final position from the rear panel. Check for an accurate fit of the connectors afterwards.

Re-assemble the instrument the opposite order as described.

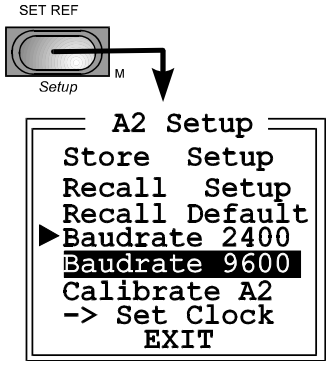
Connect the A2 with mains power. There is no calibration required, except when calibration data has to be corrected.

The communication parameter are fixed as follows.

Baudrate	2400 / 9600 / 19200 / 38400 Baud
Databits	7
Stopbits	1
Parity	even

Baud Rate Selection

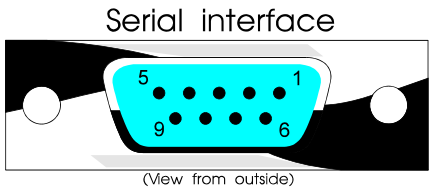
To select the baud rate (communication speed) of the serial interface, activate the menu behind the <SET REF> (Setup) key.



The menu offers the entries 2400 and 9600 baud for AO1, and 9600, 19200 and 38200 Baud for AO16. The one that is displayed inverted, is actually selected. To alter the selection move the arrow of the menu with the <SCALE> wheel to your new choice and push the <SCALE> wheel to make the selection active. Leave the menu through EXIT or any other keypress.

Connection to the PC is performed through a female 9 pin Sub -D connector. For pin layout and pin description, see PIN layout.

Pin Assignment

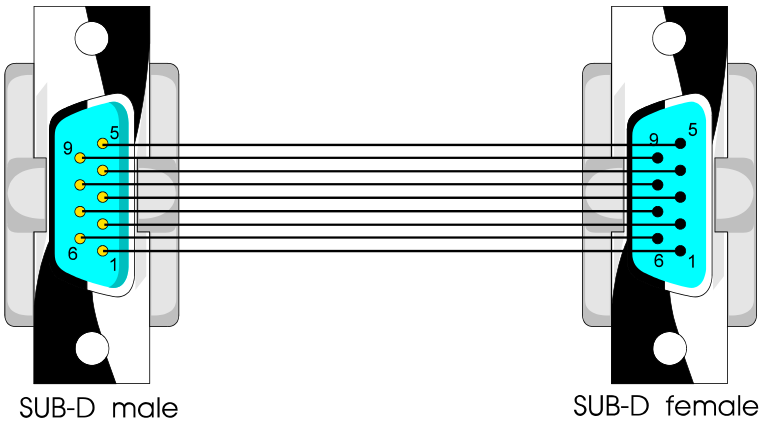


Pin No	Name	Type	Description

1	+5V	Output	+5V from A2
2	TXD	Output	Send DATA
3	RXD	Input	Receive DATA
4	DTR	Input	Data terminal ready?
5	RSGND	I/O	DATA GND
6	DSR	Output	Data set ready! (+5V)
7	CTS	Input	Clear To Send
8	RTS	Output	Request To Send
9	--	--	NC

Cables

To connect the A2 serial interface with the PC, a 1:1 cable is required, which can be purchased easily. When assembling the cable please follow the wiring list below.



SUB-D male SUB-D female

Installation of Filters AO4 / AO5 / AO13 / AO14

Basically, there are four different filter options available which may be inserted into the signal path of A1 / A2 providing following characteristics (function LEVEL).

- AO4 A-Weighting Filter RMS rectified A-weighted measurements (IEC651)
- AO5 User Definable Filter Any user defined active filter with freely setable frequency response
- AO13 C-Message Filter C-Message characteristics
- AO14 80kHz Low Pass Filter 3rd order low pass filter with 80kHz cutoff frequency.

Please note that installation of any filter provides the described characteristics for the upgraded channel only. If a measurement shall be carried out simultaneously on both channels, two identical filters have to be installed (only possible with A2).

Design rules for AO5 user definable filter are described below in this manual.

Please notice, that some restrictions apply for filter installations concerning the A2 serial number, the required firmware (EPROM) version and the number of filter options.

The installation of a single filter option requires firmware 1.14 or higher, while the installation of 2 pairs of identical filters in the A2 requires firmware version 2.40 or higher. The max. number of filter options which may be installed is described below.

	A2 S/N < 400	**A2** S/N ≥ 400
1-channel measurem.	AO4 *or* AO5 on the main channel	2 different filters AO4, AO5, AO13 or AO14, installed both on the main channel
2-channel measurem.	2 filters AO4 *or* AO5 (both filters of same type -1 pcs. per chn.)	2 different pairs* of AO4, AO5, AO13 or AO14 (2 filters on both channels)

*: firmware V2.40 or higher necessary

Inventory

The filter kits comprise following components.

	AO4	AO5	AO13	AO14
Filter board	1	1	1	1
Connector rows	2	2	2	2
Fixing screw M3x5	1	1	1	1
Spare distance holder 12mm	1	1	0	0
Pair of anti-serial Tantalum capacitors	1	1	0	0
Installation instructions	1	1	1	1

Required Tools:Screwdrivers

1) Disconnect the instrument from mains power.

2) Remove the top cover and the front panel as shown in chapter *Disassembly of the Instrument*.

3) Remove both MAIN and ALT channel board of the Analyzer (top sandwich).

4) Disassemble the ALT channel from the MAIN channel PCB.

5) Take the MAIN channel Analyzer PCB in front of you (A2P03B for S/N <400, ASP03D else).

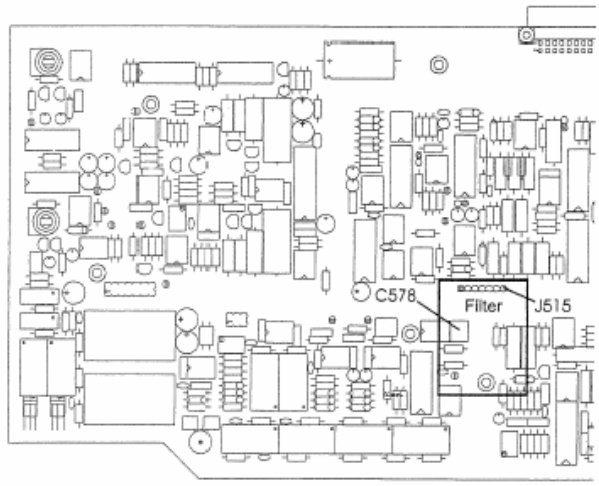


Fig 1 A2P03B

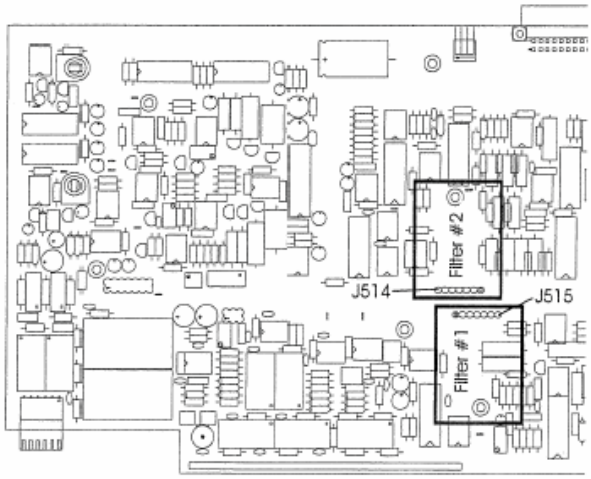


Fig 2 A2P03D

6) For A2 with S/N <400, solder in the connector row at location J515.

When installing a filter with an analyzer PCB revision of A2P03D or later as well as when installing filter option AO13 or AO14, please skip steps 7) to 10) and continue with step 11).

7) Solder out C578 (1µF). This capacitor is physically too large.

8) Solder in the pair of anti-serial Tantalum capacitors at the place where C578 was.

9) Change the distance holder (short) against the attached 12mm type.

10) Mount the second attached connector row onto the one previously soldered in.

11) Plug the FILTER board into the (stacked) connector with the solder side up.

12) Fix the PCB with the screw from the solder side.

If the *alt* channel shall *not* have a filter installed, the weighted measurements must always be performed in the single channel mode, i.e. on the MAIN channel.

Since in this case the alt channel cannot measure any reliable result, pin 2 and 5 of the connector J001 on the ALT channel board (AxP07x) must be shorted.

A1 & A2 Filter Installation on the ALT Channel

If you have already installed a filter on the MAIN channel and wish to install the same type of filter on the ALT channel, then a second filter set is required.

With only one filter installed in the MAIN channel, continue with step 19).

13) Take the ALT channel Analyzer PCB (PCB A1P07D or A2P07B) in front of you.

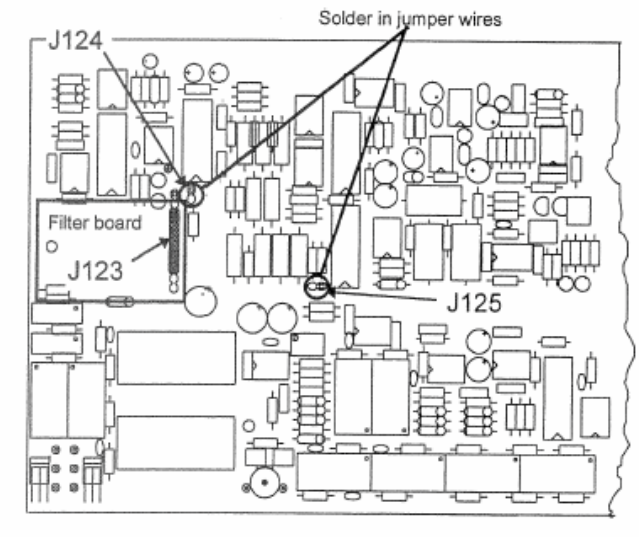


Fig 3 A1P07D

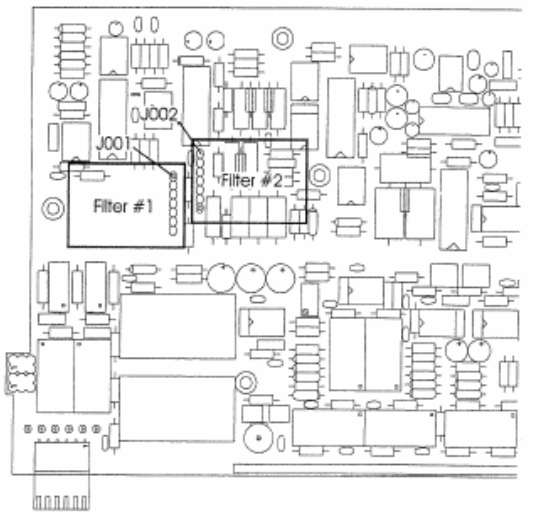


Fig 4 A2P0B

If you have PCB A2P07 revision B or later, skip steps 14) to 16) and continue with 17).

14) For the first filter option on the ALT channel, solder in the attached connector row at location J123. Leave the top two pins and the bottom two pins unconnected.

15) Add a jumper wire (J124) just to the right of the connector row.

16) Add another jumper wire (J125) a few centimeters to the right of the newly installed connector row.

17) Plug the FILTER board into the (stacked) connectors with the solder side up.

18) Fix the PCB with the screw from the solder side.

If the *ALT* channel shall *not* have a 2nd filter installed, the weighted measurements must always be performed in the single channel mode, i.e. on the MAIN channel.

Since in this case the ALT channel cannot measure any reliable result, pin 2 and 5 of the connector J002 on the ALT channel board must be shorted.

19) Remount the ALT channel onto the MAIN channel

20) Insert the sandwich of ANALYZER boards together with the screening plate back into the same position. Check for correct insertion into the connectors at the rear.

21) Connect all the cables to the same connectors as disconnected in step 2) and 3).

22) Mount both front panel and top cover with the eight corner screws. Please check that the PCB locates into the groove of the holder on the keyboard PCB.

23) Connect the instrument to the mains power.

24) Enter into the setup screen of the A1/A2 by pressing <SET REF> key during power up. Release the <SET REF> key as soon as the "Calibration & Adjustmen" screen is displayed.

38) The <WTD UWTD> key toggles the settings between NO OPTION, 1FILT and 2FILT. Please select the appropriate status according to the installed of filter options in your instrument. Incorrect setting does not activate the filter(s).

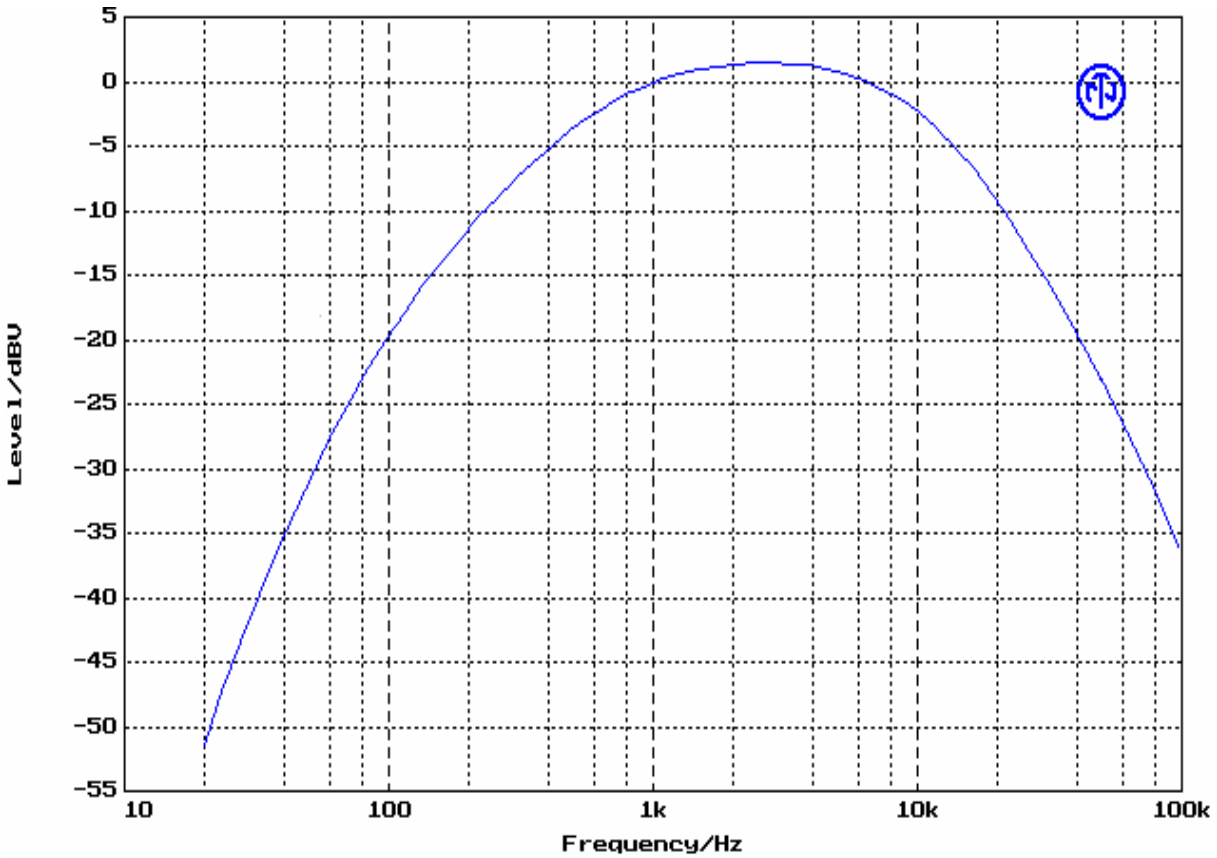
39) The setup screen can be left by selecting the RESET function (<L.REL> key) or by switching OFF and ON the A2. If the software has been upgraded then the unit will auto calibrate.

Should the system calibrate then ensure that the calibration is repeated once more after a warm-up period of at least 30 minutes.

The installation of the filter is now complete. The <WTD UWTD> key can now be pressed in measurement function LEVEL to activate/deactivate the filter.

Filter Characteristics AO4 A-Weighted Filter

Frequency [Hz]	Gain [dBv]	Limits [±dBv]	Frequency [Hz]	Gain [dBv]	Limits [±dBv]
16	-56.7	+2 / -∞	630	-1.9	0.7
20	-50.5	2	800	-0.8	0.7
25	-44.7	1.5	1000	0	0.7
31.5	-39.4	1	1250	+0.6	0.7
40	-34.6	1	1600	+1.0	0.7
50	-30.2	1	2000	+1.2	0.7
63	-26.2	1	2500	+1.3	0.7
80	-22.5	1	3150	+1.2	0.7
100	-19.1	0.7	4000	+1.0	0.7
125	-16.1	0.7	5000	+0.5	1
160	-13.4	0.7	6300	-0.1	+1 / -1.5
200	-10.9	0.7	8000	-1.1	+1 / -2
250	-8.6	0.7	10000	-2.5	+2 / -3
315	-6.6	0.7	12500	-4.3	+2 / -3
400	-4.8	0.7	16000	-6.6	+2 / -3
500	-3.2	0.7	20000	-9.3	+2 / -3

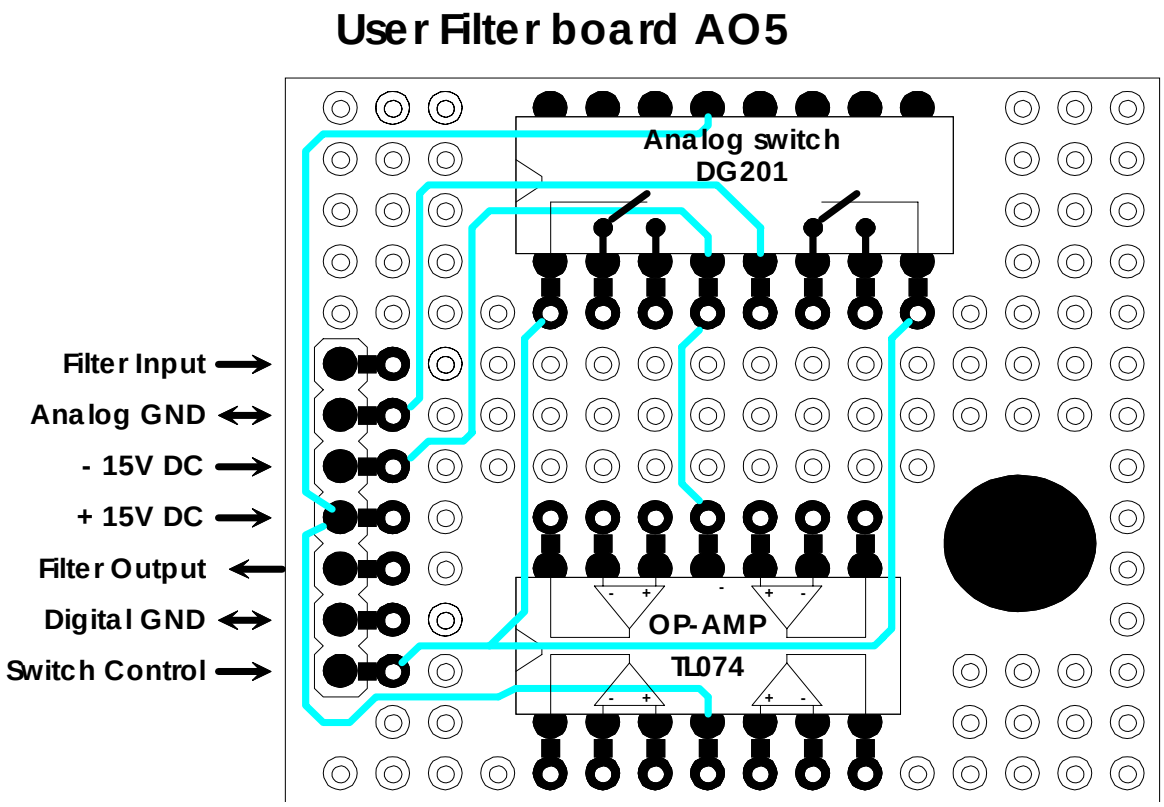


AO5 User Definable Filter: Design and Assembly

There is no filter structure on the AO5. It is just prepared to wire your own filter design.

The AO5 is a filter board equipped only with an analogue switch and 4 operational amplifiers. The switches which insert the filter into the analyzer path, are fully controlled by the instrument. The control lines for two switches as well as all power lines are pre-wired on the PCB.

Please follow the design rules below.



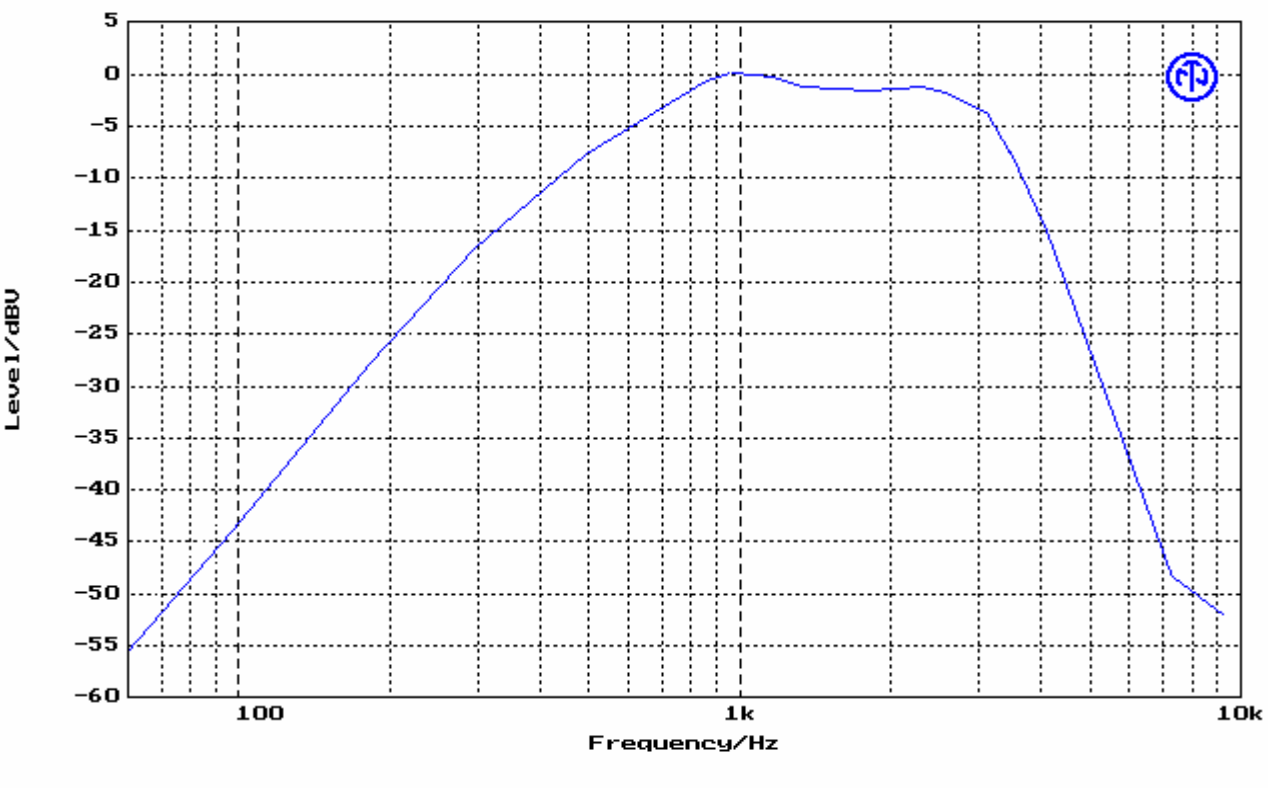
- The switch itself is not included on the pre-wired design. Set at least one switch at the end of your filter structure to decouple it from the normal path.
- In the TL074, there are four unassigned OP-AMPs to be used for the filter structure. Leave the unused OP-AMPs unconnected.
- The input impedance of the filter must not be lower than 5kΩ. Use a buffer OP-AMP if this should be the case.
- The maximum component height is limited to ~7mm due to inverse mounting.
- Two analogue switches are unassigned in the DG201 and can be used freely. Any voltage between 5V and VCC activates the switch.
- In order to get proper measurement results, the filter must have a unity gain of 8.1 dB.

Wire up you filter structure and carefully check before you continue with the installation.

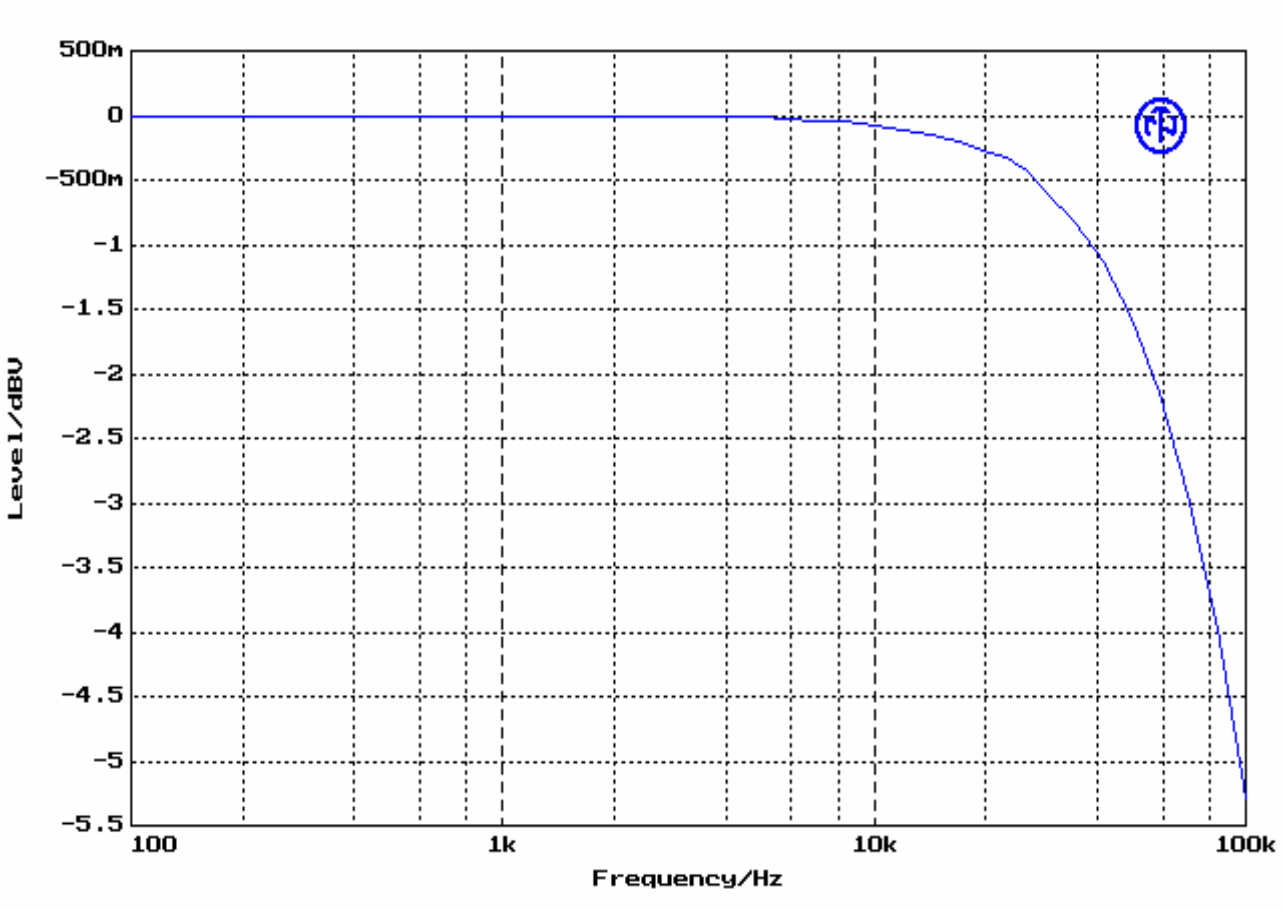
Filter Characteristics of AO13 C-Message Filter

PCB No: A2 P17A, SCH No: A2 S36A

Frequency (Hz)	Gain (dBv)	Limits (±dBv)	Frequency (Hz)	Gain (dBv)	Limits (±dBv)
60	-55.7	2	1300	-0.7	1
100	-42.5	2	1500	-1.2	1
200	-25.1	2	1800	-1.3	1
300	-16.3	2	2000	-1.1	1
400	-11.2	1	2500	-1.1	1
500	-7.7	1	2800	-2.0	1
600	-5.0	1	3000	-3.0	1
700	-2.8	1	3300	-5.1	2
800	-1.3	1	3500	-7.1	2
900	-0.3	1	4000	-14.6	3
1000	0.0	reference	4500	-22.3	3
1200	-0.4	1	5000	-28.7	3



AO14 80kHz Low Pass Filter



Phantom Power Supply

Components Required

4 resistors 6.8kΩ (bl/gr/sw/bn), 4 resistors 1.0kΩ (bn/sw/sw/bn)
2 diodes 1N 4148, 2 resistors 100Ω (bn/bk/bk/bk).

Installation

Disassemble the A2 as shown in chapter *Disassembly of the Instrument*.

MAIN Channel Modification

The analyzer modifications below change the function of the lowest impedance and enable the Phantom power on the MAIN (illuminated) channel.

2.1 Solder out R511 and R512

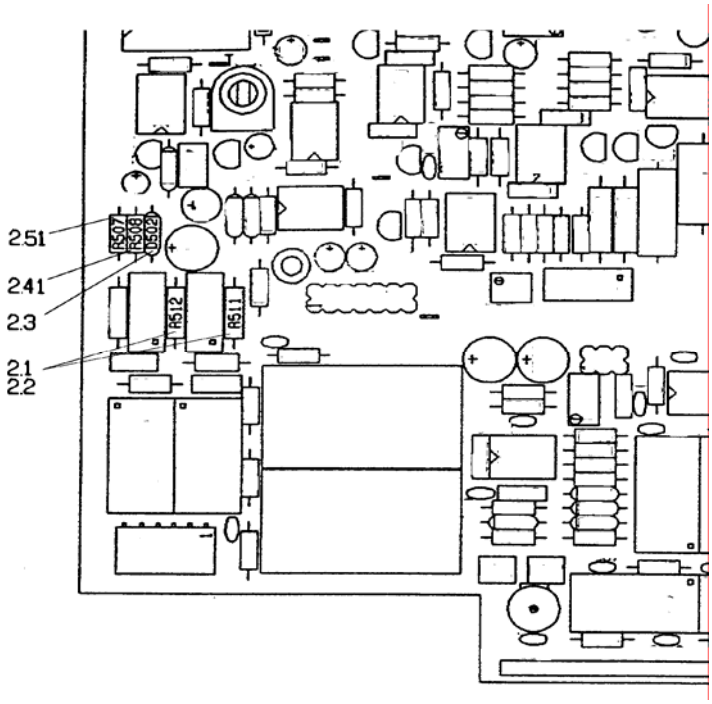
2.2 If you desire +15V Phantom power voltage then solder in two 1kΩ resistors where the R511 and R512 have been before. If +48V is required then use 6.8kΩ resistors instead.

2.3 Check for the diode D502. It has to be in. If it is not in, then solder in the diode.

2.4 If you desire +15V Phantom power, then continue with 2.41 otherwise go to 2.5.

2.41 Solder in R508 which is a 100Ω 1% resistor.

2.42 Continue with 3.0



2.5 Only proceed this step if you want +48V Phantom power and do **not** proceed 2.41 before.

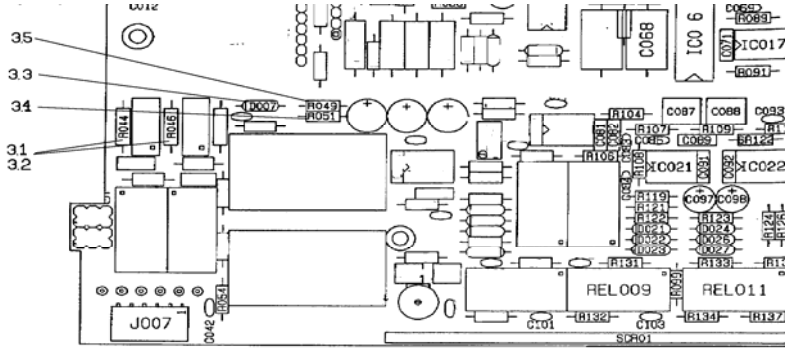
2.51 Solder in R507 which is a 100Ω 1% resistor.

ALT Channel Modification (for A2 S/No >400)

The modification step 3 changes also the alternate channel from low impedance to Phantom power. If only **one** channel (MAIN) shall be equipped with Phantom power then **skip step 3 and 4 and continue with 5.0.**

Only proceed if you really want to have both channels equipped with Phantom power.

Note	**Only proceed this step if you have an A2 with a serial number >400. Should your instrument be of a lower serial number then skip 3. and proceed with 4.**



3.1 Solder out R044 and R046.

3.2 If you require +15V Phantom power solder in 1.0kΩ resistors where the R044 and R046 have been before. For +48V Phantom power use the 6.8kΩ resistors instead.

3.3 Check for the diode D007. It has to be in. If not solder in the diode.

3.4 If you want to have +15V Phantom power then solder in R051 which is a 100Ω/1% but do **not** solder in R049 under 3.5.

3.5 If you want +48V Phantom power then solder in R049 but ensure that you have **not** soldered in R051 previously. The +48V are supplied through this resistor.

3.6 Goto 5.0

ALT Channel Modification (for A2 S/No <400)

The modification step 4 changes also the alternate channel from low impedance to Phantom power. If only one channel (MAIN) shall be equipped with Phantom power then skip step 4 and continue with 5.0.

Only proceed if you really want to have both channels equipped with Phantom power.

Note:	**Only proceed this step if you have an A2 with a serial number <400. Should your instrument be of a higher serial number got back to 3.**

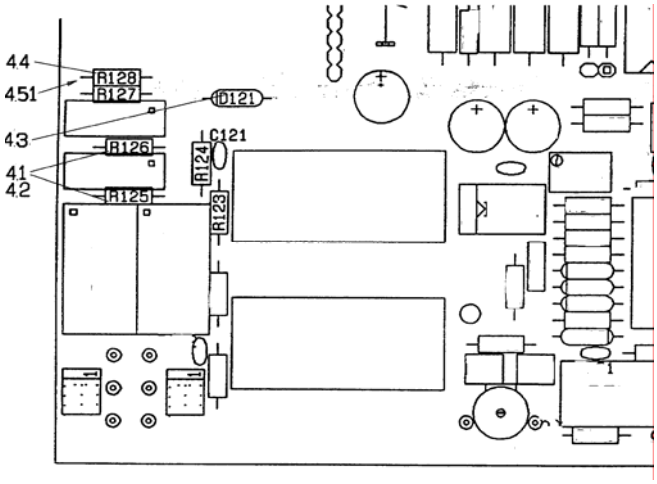
4.1 Solder out R125 and R126

4.2 If you require +15V Phantom power then solder in the two 1.0kΩ resistors where the R125 and R126 have been before. Should you require +48V Phantom power voltage then use 6.8kΩ resistors instead.

4.3 Check for the diode D121. It has to be in. If not solder in the diode.

4.4 Solder in R128 which is a 100Ω 1% resistor.

4.41 **If you want +15V Phantom power then continue with 5.0 otherwise go to 4.5**.



4.5 **Only proceed this step if you want +48V Phantom power and if the serial number of your A2 is <400.** The alternate channel of these instruments is only equipped for +15V. Therefore to have the +48V available, it is necessary to wire the voltage supply from the lower board up.

4.51 Isolate the left side (toward outside of the board) pin of the resistor R128 by cutting the track leading to that pin.

4.53 Add a wire from the isolated pin of R128 to J128 pin 14. Use a thin wire and glue it at a few points to the board to avoid vibrations.

4.54 Take the MAIN channel analyzer board and cut the track leading to pin 14 of J528. It is an unused track.

4.55 Add a wire from J528 pin 14 to J505 pin 20 (one of the connectors to the motherboard). This wire brings the +48V to the connector and feeds it that way up to the ALT channel.

Check and Setup

5.1 Check once more all steps you have performed and ensure that all solder joints are done properly.

5.2 Assemble now the Analyzer with the two board and the IMD on top.

5.3 Switch the unit On and press <SET REF> to get into the configuration screen.

5.4 In the configuration screen, the made changes have to be set. The entries on this screen refer to the keys of the whole right side keyboard.

5.5.1 The button <22-22k> BP filter toggles the entry between PHANT. SELECT and IMPED. SELECT. Choose PHANT. SELECT.

5.5.2 Leave the configuration screen by pressing measurement function THD+N. This resets the unit and return to normal operation.

5.6 Test the function of the Phantom power my measuring the DC voltage between the active XLR input pin 2 and pin 1. It has to be +15V or +48V depending on your selection.
Test also between pin 3 and pin 1. The same voltage has to be displayed on your DVM.
Test between pin 2 and pin 3 of the input. A very low voltage close to zero has to be on the display.

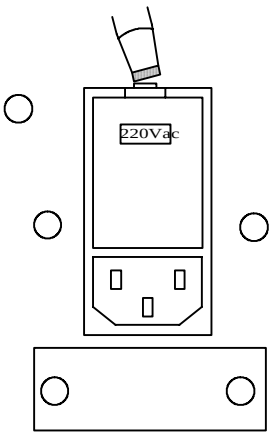
5. TROUBLESHOOTING

To localize a problem with the A2 system it is essential to test first the most likely possibilities and only then go into further analysis. Use the calibration/self test find a first approach and then with a careful analysis of the error message combined with a good understanding of the system architecture, the fault-finding is not too complicate.

A2 Does Not Start Up

Select Mains Voltage

Before connecting power to the A2 make sure that the power source matches the power requirements, as marked on the connector/fuse holder assembly on the chassis rear. If the instrument is incompatible with the available power source, go through the following paragraph to adjust the power requirements.



The A2 can operate from 100VAC, 120VAC, 230VAC and 240VAC. To reconfigure the input line voltage remove the mains cable and open the flap of the connector/fuse holder assembly at the back side of the A2 by pressing a small screwdriver into the slot on the top.

Take out the drum and insert it in the new position. The label pointing toward the operator indicates the selected line voltage.

At the same time a fuse with the proper current rating must be installed. For 100 / 120VAC a 2A fuse has to be used while in 230 / 240VAC position a 1A fuse is required.

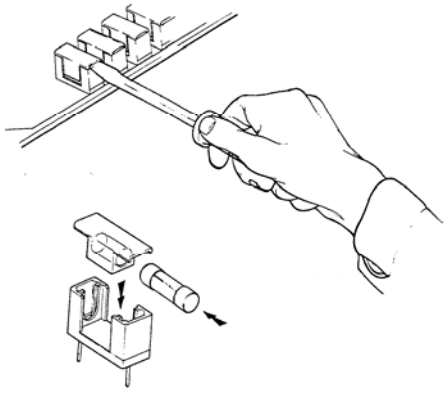
After installing the proper fuse and setting the desired line voltage close the flap and insert the power cable. Before switching on the A2 check if the voltage selector at the rear panel is switched to the right voltage.

Check Mains Fuse

Should the instrument be once connected to 230V with the 100V voltage setting and the proper fuse inserted then the mains fuse will immediately blow to protect the instrument. To remove and install the fuse refer to the part *Select Mains Voltage* above. To check the fuse itself an visual test is not enough. Take either a Ohm-Meter to make sure that the fuse has a resistance lower than 1Ω, or take a new fuse.

Check 5V Fuse

To do so remove the bottom cover of the A2 as described in *Disassembly of the Instrument*. Be careful not to damage the speaker cable.



At the motherboard PCB (vertical) there are four fuses on each side. Each fuse is labeled on the PCB solder side. Check the "5V Main" fuse. Lift the fuse-holder cap with a screwdriver. Carefully check the fuse and replace it by a 2AT type if necessary. Be careful not to bend the print too much.

Startup O.K., but No or Black Display

Check Contrast Potentiometer

Turn the contrast potentiometer from one limit to the other while watching the display.

Check Analyzer Fuses

Remove the top cover of the A2 as described under *Chassis Removal* Six fuse-holder become visible on the motherboard (vertical). Each fuse is individually labeled on the solder-side of the PCB. Look for the two fuses labeled with "ANA 15V". Check and possibly replace these fuses with 1AT fuses.

No Generator Signal - Display and Functions OK

Check Generator Fuses

Remove the top cover of the A2 as described under *Chassis Removal* Six fuse-holder become visible on the motherboard (vertical). Each fuse is individually labeled on the solder-side of the PCB. Look for the two fuses labeled with "GEN 15V". Check and possibly replace these fuses with 1AT fuses.

Measurements not Accurate or Faulty

Should the environmental condition change massively, then the a re-calibration of the system is recommended. Calibrate the instrument by selecting the menu behind the <SET REF> key with a double click. Select "Calibrate A2" from the menu.

Only calibrate the instrument after a warm-up period of 30min.

Inaccurate Output Voltage

The absolute output voltage of the generator has to be set in the adjustment procedure with an accurate AC level meter. Please refer to *Generator Adjustment* to do the re-adjustments.

Residual Distortion Problems

If distortion is very high, possibly one fuse of the analyzer of generator supply may be blown. Check the fuses of analyzer and generator.

Try to localize whether it is an analyzer distortion problem or whether the generator is at fault. This can easiest be done by using an independent generator/analyzer as the NTI A1 or A2 and check this out. This diagnosis is essential for the further fault findings. Also perform a distortion sweep versus frequency and amplitude to get additional information about the fault.

Also try to determine whether the measurement results are caused mainly by distortion or by< noise. Use an oscilloscope at the READING output of the "properly working" test instruments to see the residual signals. In many case the electronic devices under test are causing an unexpected amount of noise that is wrongly interpreted as a faulty measurement.

Analyzer Distortion Problems

If analyzer distortion is not as good as specified but no fault can be localized, try to re-adjust the distortion of the analyzer. Please refer to the chapter *Analyzer Adjustment* for details.

Phase Measurements not Accurate at High Frequencies

Adjust the CMRR on the Analyzer as well as on the ALT channel. Please refer to chapter *Analyzer Adjustment* for details.

Calibration Stops with Error Message

Continuity Check

No external connection must be made during calibration. Any external voltages or short circuit of pins results in errors and wrong calibration results.

The calibration process first starts with a continuity check to see whether all signals are present and in the right level and frequency range.

Step	*Description*	*Error message*
1.1	*Generator Readback A*	*GAIN 01 low*
1.2	*Generator Readback B*	*GAIN 02 low*
1.3	*Analyzer Input RMS*	*GAIN 03 low*
1.4	*Analyzer AVG converter*	
1.5	*Analyzer Output RMS*	
1.6	*Phaseboard (ALT channel) Input RMS*	
1.7	*Phaseboard (ALT channel) AVG converter*	
1.8	*Phaseboard (ALT channel) Output RMS*	

Should there be certain signals not available an error message is displayed and calibration stops.

Gain 01 low — The gain of the readback signal to be calibrated was too low. It indicates that there is no output signal of the generator available. Reasons could be DSP not working (check the digital line DATA, B_CLCOK and SAMPLE) or the D/A converter could be at fault. (Check all reference voltages around and measure output voltage). Further it could also be that the signal get lost in the power amplifier due to possibly missing supply voltages. Best approach with this error message is to carefully follow the signal all the way through the output circuitry.

Gain 03 low — No signal at the analyzer input available. Most likely a cable from the front panel is not connected to the analyzer or a cable is not properly connected. Check also cable solder joints on the front panel PCB for broken wires. Also possible that the connection cable between ALT channel and MAIN channel analyzer board is missing (new instruments use connector row J005) Or ALT channel could be not properly set up in the connector rows.
Please note that during the calibration process no generator signal is available at the XLT outputs of the generator. For test purpose the generator signal can be found on the 5 pin MOLEX connector J900. The top two pins carry the balanced output signal of the generator. If this signal is O.K. then follow the signal and measure it at the inputs of the ALT channel board. If a loss of half the voltage (6dB) occurs, then most probably a cable wire is broken.

Gain 04 low — Average converter does not get signal. Most probably the IMD board is not assembled. Insert a jumper between Pin 2 and 8 of J507 if board is not available for assembly.

Other errors — Check first the analyzer. For fault-finding on the main channels analyzer board the ALT channel as well as the IMD board can be disassembled (don't forget jumper between pin 2 and pin 8 of J507 to re-route signal around the IMD PCB). Check the voltage at the test-points TP519 and TP515. The calibration sequence lists the expected voltage level for every calibration step.

If the voltage level at TP519 is incorrect then the analyzer input stage is suspicious. If the level at TP519 was o.k. but missing or incorrect at TP515 then most probably the measurement amplifier is at fault.

Fax NTI service department if in doubt and report the measurements and results.

6. ADJUSTMENTS

Recommendations

Calibration Interval

NTI recommends a 12 month calibration interval for the A2. More frequent calibration may be required if the instrument is used under extreme environmental conditions. On the other hand with no indications on drifts the interval may also be prolonged.

Required Tools and Equipment

The following measurement equipment is required to properly perform the adjustments. Do not compromise on the accuracy of the instruments or absolute accuracy may not be adjustable.

- *AC/DC voltmeter with accuracy <0.1%*
- *Frequency counter, ±10ppm, >=5 digits*
- *THD Measurement system <-90dB (an A2 for example)*
- *CMRR test cable (See below)$*
- *Oscilloscope >20MHz bandwidth*

Preparation

Note	Warm up the instrument for at least 30 minutes before doing any adjustments or calibration.

Unplug mains connection and disassemble front panel and top cover of the instrument as explained in section *Chassis Removal*. Also disassemble the bottom cover.

Output Stage Adjustment

This adjustment procedure is not required if the transformer option AO7 is not installed.

The transformer circuitry has to be optimized for lowest distortion. Connect therefore a high performance distortion meter to the output of the A2. It is not recommended to use the analyzer of this A2. Better use another A2 instrument. Do not use an A1 instrument, its residual distortion are not sufficient for this step!

Set the generator to 20Hz and maximum output voltage.

Adjust with a small screwdriver the potentiometer of the transformer sub-board to minimum THD+N. The trimmer can be reached from the bottom side of the A2.

Reduce the level to 5.8V and adjust THD+N to minimum with the trimmer RT201 on the motherboard. Again reach the trimmer from the bottom. Typical THD+N values to reach are -90dB.

Repeat steps above for best distortion values.

After this adjustment you have to do the Generator adjustment.

Generator Adjustment

To adjust the generator, the Analyzer PCBs have to be removed. Switch the instrument Off and remove the Analyzer PCB with the ALT channel PCB so that only the front panel is connected with the two flat cables and the Gen. Signal cable µP/Gen as well as the motherboard.

The generator adjustment procedure is done under software control. To enter "Calibration and Adjustment" screen, simply keep the <SET REF> key pressed during power up (refer to chapter *8. Calibration – Calibration Screen*). To start the generator adjustment procedure (ADJ.GEN.) you have to press the <SWEEP MODE> key. The procedure can be aborted any time by pressing the <THD+N> key (RESET). Press the NEXT STEP (<START VALUE> key) to step through the adjustment procedure.

Maximum Level Adjustment

The first step in the adjustment menu is the absolute maximum level adjustment. Use RT355 to adjust for 24.9 Volt ±5mV at the A2 output. Measure the voltage between pin 2 and 3 of the generator output B.

Minimum Distortion Adjustment

The second step of the adjustment menu is the THD adjustment with RT351 and 353. The THD value has to be measured with another unit (better than 90dB at 20Hz). Minimize the THD value, but note that there is some interaction between these two potentiometers. Repeat the adjustment until you achieve the absolute optimum.

Analyzer Adjustment

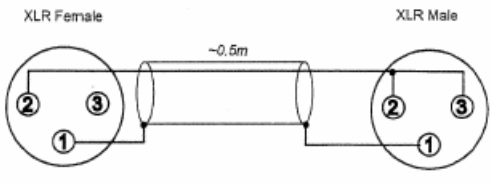
Switch off the instrument and re-install all analyzer boards. Connect all cables but do not attach the front panel to the housing. The handle in its front position may help to keep the panel in position. Remove the IMD board if you intend to do the Notch-tune adjustment and replace it by a wire bridge from pin 2 to 8.

The analyzer adjustment procedure is done under software control. To enter adjustment mode simply keep the <SET REF> key pressed during power up. The adjustment screen is now displayed (see chapter *8. Calibration - Calibration Screen*).

The special screen represents the special functions of the right side of the keyboard. To get the analyzer adjustment procedure (ADJ.ANA) you have to press the <STOP VALUE> key. The procedure can be aborted any time by pressing the RESET key (<THD+N> key). Press the NEXT STEP (<START VALUE> key) to step through the adjustment procedure.

CMRR 1 Adjustment

Use external CMRR cables (see Diagram) between output A and input A also between output B and input B. Ensure that the generator mode switch on the back side of the instrument is set to GND position.



Adjust the upper bargraph with RT506 on the Analyzer PCB and the lower bargraph with RT001 On the ALT channel PCB for minimum. If only one CMRR cable is available then use the cable in channel A for RT506 adjustment and in channel B for RT001 adjustment.

If you have no IMD board assembled you have to short-circuit pin 2 and 8 of the IMD connector J507 to get the signal through.
Press the NEXT STEP (<START VALUE> key) when ready.

CMRR 2 Adjustment

Preparations as described at CMRR 1. Adjust the upper bargraph with CT501 on the Analyzer PCB and the lower bargraph with CT001 on the ALT channel PCB for minimum. If only one CMRR cable is available then use the cable in channel A for CT501 adjustment and in channel B for CT001 adjustment.
Press the NEXT STEP (START FREQ) key when ready.

Notch Gain

Disconnect the cables. Use the bar graph in menu screen to adjust for minimum with RT504. The value should be between -20dB and -50dB.
Press the NEXT STEP (START FREQ) key when ready.

Notch Tune

Use the bar graph in menu screen to adjust for minimum with RT501 and 502 (Note: There is some interaction between RT501 and 502). The value should be less than -80dB.

THD Offset Adjustment

This step is important to maximize the speed of the THD measurements. The notch filter has two ranges. Maximum speed can be achieved if the DC voltage in both ranges is the same. It does not have to be zero, the equality of the level is important.

Connect the voltmeter between TP515 (DC mV mode) and AGND. The display in the calibration message shows:

```
....adjust TP515....
F..<-
```

on the display. This now the upper range. By turning the <FREQUENCY> wheel one or two steps to the **LEFT**, the display changes to:

```
....adjust TP515....
->  F
```

Turn the wheel back and it changes to the original display. Turn the wheel back again and monitor the voltage change on the DVM when changing the ranges. If the level change is more than 0.2mV then go back to the original position and try to minimize the **change** by adjusting RT505. Repeat the steps and the adjustment until no or nearly no voltage **change** is measurable when changing from one range to the other. The absolute voltage level at this point is between -15mV and +15mV.

W&F Adjustment

No cables connected!

At the first step measure and note the DC voltage at IC555/1 (or TP526 on >400) with your voltmeter.

Press the NEXT STEP (<START VALUE> key) to continue.

Use RT508 to adjust DC voltage at IC555/1 (or TP526 on >400) to the same value as before.

Press the NEXT STEP (<START VALUE> key) to continue.

Adjust measured value for W&F with RT510 as close as possible to 1%.

Press the NEXT STEP (<START VALUE> key) to continue.

Check if the W&F value is 0.7% within 0.1%.

Press the NEXT STEP (<START VALUE> key) to restart the unit.

7. PERFORMANCE VERIFICATION

This performance verification can be carried out by the customer to verify the basic system functionalities.

Required items:

- *AC/DC voltmeter with accuracy <0.1%*
- *Frequency counter, ±10ppm, >=5 digits*
- *THD Measurement system <-90dB (an A2 for example)*
- *Short-circuit connector*

a) Complete the Calibration Procedure, according to Service Manual, chapter 8. Verify the self calibration is PASSED.

b) Set the instrument to max. output level to +30dBu, 1kHz, and measure 24.495V ±5mV at the A2 generator output B between pin 2 and 3.

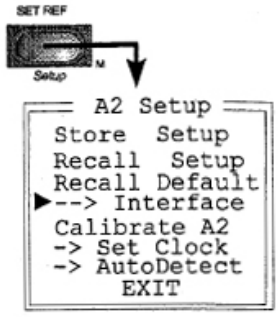
c) Set the instrument to max. output level to +30dBu, 1kHz, and measure THD better -90dB at the A2 generator output B between pin 2 and 3.

d) Select the LEVEL function with Filter 22Hz-22kHz activated and use a short-circuit connector (pin 2-3). Plug this connector into input channel A. The residual noise shall be < 3 microVolt. Measure the same at channel B.

8. CALIBRATION

The A2 instrument provides an automatic self-calibration sequence, that lets the instrument calibrate automatically all its measurement amplifiers and generator settings. The calibration values are internally stored in an EEPROM (non volatile memory)

To start the calibration process, ensure that the instrument is completely assembled, all covers closed and properly warmed up for at least 30 minutes. Ensure that no external connections are made to the instrument.
Activate the "Setup" menu by double-clicking the <SET REF> key and select "Calibrate A2" with the <SCALE> wheel. Press the <SCALE> wheel for confirmation.



Calibration Sequence

The following table lists the calibration sequences and steps. The columns labeled "Freq.", "Gen.", "TP519" and "TP515" indicate the set values that must be present at these points at the respective calibration steps, if the instrument is calibrated correctly.
If the calibration procedure stops with an error message at any step, check whether the corresponding frequency and voltages are correct. This may help you to detect the cause of the error.

Software version 2.10 and up

Sequ. No.:	Message Displayed	Step No.: Actually calibrating	**Freq.**	**Gen.** in Vrms	**TP519** in Vrms	**TP515** in Vrms
			± 0.1%	± 10%	± 10%	± 10%
1	Continuity Check	1. Generator Readback A	1kHz	2.5V	2.50V	1.00V
		2. Generator Readback B	1kHz	2.5V	2.50V	1.00V
		3. Analyzer Input Rms	1kHz	2.5V	2.50V	1.00V
		4. Analyzer AVG Converter	1kHz	2.5V	2.50V	1.00V
		5. Analyzer Output Rms	1kHz	2.5V	2.50V	1.00V
		6. Phaseboard Input Rms	1kHz	2.5V	2.50V	1.00V
		7. Phaseboard AVG Converter	1kHz	2.5V	2.50V	1.00V
		8. Phaseboard Output Rms	1kHz	2.5V	2.50V	1.00V
2	Calibrating Source Filters	1. Generator LowPass Reference	1kHz	2.9V	2.90V	
		2. Generator Filter Ripple Cal.	2-100k	2.9V	2.90V	
3	Calibrating Filter Frequency	1. Notch filter center freq. dec. 1*	112Hz	2.5V	2.50V	1.00V
		2. Notch filter center freq. dec. 2	720Hz	2.5V	2.50V	1.00V
		3. Notch filter center freq. dec. 3	5.5kHz	2.5V	2.50V	1.00V
		4. Notch filter center freq. dec. 4	25kHz	2.5V	2.50V	1.00V
4	In/Output RMS Detector Calibration	1. Cal. input RMS detector factor 0dB	1kHz	2.9V	2.90V	1.16V
		2. Cal. output RMS detector const.	1kHz	2.9V	2.90V	1.16V
		3. Cal. factor for meas. amp. 0dB	1kHz	2.9V	2.90V	1.16V
		4. Cal. IMD Filterfactor	10kHz	0.725V		
		5. Cal. DFD Filterfactor	60Hz	2.9V		
5	Calibrating Source Attenuator	1. Cal. 3dB attenuator	1kHz	2.8V		
		2. Cal. 6dB attenuator	1kHz	2.8V		
		3. Cal. 12dB attenuator	1kHz	2.7V		

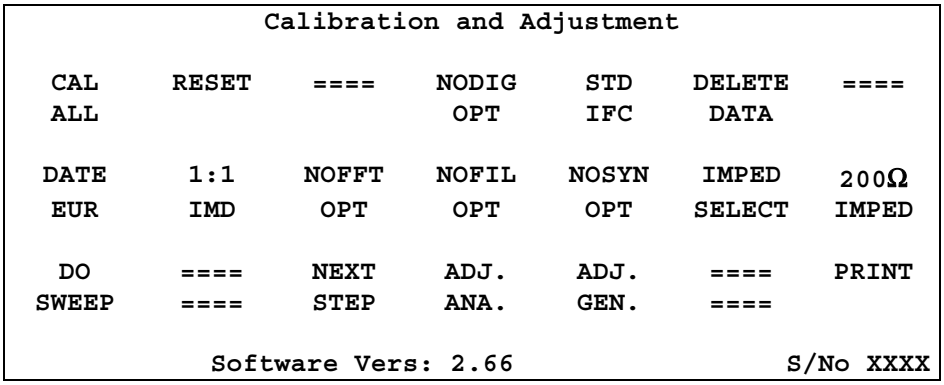
* Frequency in Notch filter calibration may vary ±30% for all four decades.

Sequ. No.:	Message Displayed	Step No.: Actually calibrating	**Freq.**	**Gen.** in Vrms	**TP519** in Vrms	**TP515** in Vrms
			± 0.1%	± 10%	± 10%	± 10%
6	Analyzer Input PGA Calibration	1. Inp. gain 3dB (3dB PGA, 0dB Inp)	1kHz	2.0V	2.82V	1.13V
		2. Inp. gain 6dB (6dB PGA, 0dB Inp.)	1kHz	1.45V	2.89V	1.16V
		3. Inp. gain 9dB (9dB PGA, 0dB Inp.)	1kHz	1.0V	2.82V	1.13V
		4. Inp. gain 12dB (0dB PGA, 12dB Inp.)	1kHz	680mV		
7	Input Stage +12dB +24dB Calibration	1. Cal. Generator Att. -24dB	1kHz	730mV	2.71V	1.08V
		2. Cal. input amp. +24dB (24, 0dB)	1kHz	180mV	2.85V	1.14V
		3. Calculate 24dB+6dB (not meas.)	1kHz	180mV	2.85V	1.14V
		4. Cal. -30dB & -40dB generator att.	1kHz	80mV	2.53V	1.01V
		5. Store Generator Data	1kHz	80mV	2.53V	1.01V
8	AVG and Q-Peak Detector Cal.	1. AVG converter const. 0dB, 0dB	1kHz	3.0V	3.00V	1.20V
		2. Quasipeak detector (Noise UNWTD 0dB, 0dB)	1kHz	675mV	675mV	0.27V
9	HP-, BP-, NoiseWTD Filt. Cal.	1. High pass 0dB, 0dB	1kHz	2.9V	2.90V	1.16V
		2. High pass and Band pass filter	1kHz	2.9V	2.90V	1.16V
		3. Band pass filter	1kHz	2.9V	2.90V	1.16V
		4. Noise WTD filter	1kHz	2.7V	2.70V	1.08V
10	Meas. Amp. and Gen -50dB Cal.	1. Cal. meas. amp. +12dB (0, 12dB)	1kHz	750mV	750mV	1.19V
		2. Cal. meas. amp. +24dB (0, 24dB)	1kHz	180mV	180mV	1.14V
		3. Cal. meas. amp. +36dB (0, 36dB)	1kHz	45.0mV	45.0mV	1.14V
		4. Cal. meas. amp. +48dB (0, 48dB)	1kHz	11.0mV	11.0mV	1.11V
11	Cal. Analyzer Input Att.	1. Cal. inp. att. -12dB (-12dB Inp. att. +12dB meas. amp.)	1kHz	11V	728mV	1.16V
		2. Cal. inp. att. -24dB (-24dB Inp. att. +24dB meas. amp.)	1kHz	11V	183mV	1.16V
		3. Cal. inp. att. -36dB (-36dB Inp. att. +36dB meas. amp.)	1kHz	11V	46.0mV	1.16V
		4. Cal. inp. att. -48dB (-48dB Inp. att. +48dB meas. amp.)	1kHz	11V	11.5mV	1.16V
12	Meas. Amp. +60 .. +84dB Calibration	1. Meas. amp. +60dB (-12, +60dB)	1kHz	11mV	2.8mV	1.11V
		2. Meas. amp. +72dB (-24, +72dB)	1kHz	11mV	0.7mV	1.11V
		3. Meas. amp. +84dB (-36, +80dB)	1kHz	11mV	0.2mV	1.11V
		4. Prepare Cal. of Phase 0deg	1kHz	2.7V	2.70V	1.08V
		5. Wait	1kHz	2.7V	2.70V	1.08V
		6. Wait	1kHz	2.7V	2.70V	1.08V
		7. Calibrate Phase 0deg	1kHz	2.7V	2.70V	1.08V
		8. Calculate and store analyzer data Prepare Cal. of Phase 180deg	1kHz	2.7V	2.70V	1.08V
		9. Wait	1kHz	2.7V	2.70V	1.08V
		10. Calibrate Phase 180deg	1kHz	2.7V	2.70V	1.08V
		11. Gen. readback -48dB	1kHz	24.0V		
		12. Gen. readback offset	1kHz			
		13. Gen. readback -24dB	1kHz	1.1V		
		14. Gen. readback 0dB	1kHz	70mV		
		15. Gen. readback +24dB	1kHz	4mV		
		16. Calculate and store	1kHz	4mV		

NOTE: **Should errors occurs during calibration, then please refer to chapter *5. Troubleshooting*.**

Calibration Screen

The "Calibration and Adjustment" screen may be entered by keeping the <SET REF> key pressed during power-up of the instrument. Each entry of this screen may be selected by pressing the related key on the right hand side of the front panel.



Following list gives an overview on the available entries as well as the actions / adjustments that may be started / changed by pressing the related keys.

Entry	***Key***	***Action / Adjustment***
CAL ALL	<LEVEL>	Starts the automatic calibration procedure.
RESET	<THD + N>	Resets the unit (same effect as when switching it On).
NODIG OPT / DIG OPT	<NOISE>	Allows to activate the digital option after its installation.
STD IFC / 232HS IFC / IEEE IFC	<CROSSTALK>	Allows to set the interface type to standard, high-speed RS232 or IEEE-488.2.
DELETE DATA	<PHASE>	Deletes all sweep graphic data stored in the unit.
DATE EUR / DATE USA	<METER>	Toggles between european date format (dd/mm/yyyy) and US date format (mm/dd/yyyy).
OLD IMD / 1:1 IMD	<GRAPH>	Allows to upgrade A2 units (S/N <400) with the 1:1 IMD option.
NOFFT OPT / FFT OPT	<SCOPE>	Allows to activate the FFT option after its installation.
NOFIL OPT / 1FILT PER CHN / 2FILT PER CHN	<WTD UWTD>	Allows to activate the installed filter option(s).
NOSYN OPT / SYNC OPT	<400 Hz>	Allows to activate the Sync output option after its installation.
IMPED. SELECT / PHANT. SELECT	<22-22k>	Allows to activate the Phantom power option after its installation.
150Ω IMPED / 200Ω IMPED	<UNIT>	Allows selection of the lowest input impedance for A2 units with S/N >400.
DO SWEEP	<DO SWEEP>	Starts a sweep.
NEXT STEP	<START VALUE>	Forces the unit to continue the calibration procedure.
ADJ. ANA.	<STOP VALUE>	Starts the analyzer adjustment.
ADJ. GEN.	<SWEEP MODE>	Starts the generator adjustment.
PRINT	<PRINT>	Sends the current screen content to the printer port.

9. TECHNICAL SPECIFICATIONS

Generator

Signals	Sine, Warbled Sine, Square wave, Pink- and White noise, W&F- and IMD-test signal
Frequency range	10Hz to 100kHz for Sine and Square 10Hz to 40kHz for Warbled sine, Noise and IMD-signals
Resolution	≤0.05%
Accuracy	±0.01% of defined value
Output level	Range: 10µV to 24.5V_{rms} -97.6dBu to +30 dBu
Output impedance	<15Ω (150Ω, 200Ω, 600Ω selectable)
Resolution	0.05dB
Accuracy (open circuit)	0.5% of defined value
Frequency response	±0.05dB, 20Hz to 40kHz, Reference 1kHz
THD+N	max. <-90dB or 10µV (20Hz to 20kHz, unloaded, 80kHz BW) typ. -95dB (0.002%)
Square wave	Rise & Fall times: <5µs (unloaded) Overshoot: 0.5% (unloaded)
IMD-Signal	f1: 60Hz, 250Hz, Ratio 10:1, 4:1, 1:1 f2: 4 kHz to 40kHz sweepable (according to DIN and SMPTE)

ANALYSER

Inputs	2 simultaneously operating inputs, balanced, fully differential.
Impedance	100kΩ / 50pF (150Ω, 200Ω, 600Ω, 100kΩ selectable)
Input voltage	max. 300V_{peak} or 200V_{rms}
CMRR	>80dB, (20Hz to 20kHz)

LEVEL Function

Range	1µV to 200V (-120dBV to +46dBV)
Residual noise	<1.5µV (Short circuit 22Hz to 22kHz bandwidth)
Accuracy	±0.05dB
Rectifier type	True RMS
3dB bandwidth	>250kHz

Harmonic Distortion

Method	THD+N
Fund. frequency range	10Hz to 50kHz
Display range	0.001% to 100% (-100dB to 0dB)
Input voltage	5mV to 200V
Residual THD+N	-90dB (0.0025%) max. @ DIN Audio BP, Input >0dBV -95dB (0.002%) typ.
3 dB BW	2Hz to >250kHz
Rectifier type	True RMS

IMD Function

Standards	DIN45403, SMPTE TH22.51
Low frequency	60Hz, 250Hz
High Frequency	4kHz to 40kHz
Amplitude ratio	1:1, 4:1 and 10:1 (U_{f1}:U_{f2})
Display range	0.001% to 10% (-100dB to -20dB)
Input voltage	10mV to 200V
Residual IMD	-86dB (0.005%) max. @ 250kHz BW, Input >0dBV -92dB (0.0025%) typ.
3 dB BW	2Hz to >250kHz
Rectifier type	True RMS

PHASE Function

Frequency	20Hz to 100kHz
Level range	10mV to 200V
Level difference	<18dB
Accuracy	±1 degree (20Hz to 40kHz)

CROSSTALK Function

Range	20Hz to 40kHz
Accuracy	±0.3dB
Filter	Tracking 2-pole bandpass, Q=5
Rectifier type	True RMS
Reference	Active channel Input level

NOISE Function

Filter weighted	CCIR 468-3 weighting filter
Filter unweighted	DIN audio bandpass, 22.4Hz to 22.4kHz
Rectifier	Quasi-peak according to CCIR 468-3
Residual noise	-104dB weighted -108dBu unweighted

Wow & Flutter

Standards	IEC 386, DIN45507, CCIR409, BS4047:1972 (quasi peak) NAB, JIB C5551 (average measurement) All standards weighted or unweighted
Range	10% to 0.1% full scale
Accuracy	±3% of reading
Center frequency	3.00kHz or 3.15kHz
Input voltage	100mV to 100V

Drift

Range	±15%
Accuracy	±20ppm (±0.002%)

Frequency Function

Display	Continuously displayed
Frequency range	10Hz to 200kHz
Resolution	min. 0.1%
Accuracy	±0.05%

SCOPE Function

Scale & Trigger	Automatically
Timebase	10µs/Div. to 20ms/Div.
Bandwidth	40kHz
Number of points	200

SWEEP Function

Sweep types	Frequency, Amplitude, Time, Table
Resolution	Low: 5 to 30 samples selectable High: 20 to 200 samples selectable
Sweep range	Freely selectable in f, U range of Osc.
External sweeps	Automatically synchronized
Display scales	Autoscale or manual scale with ZOOM & SCROLL 1dB to 100dB full-scale span in 1 / 2.5 / 5 / 10 steps Scroll function to center displayed curve

FILTER

400Hz HP	-3dB at 400Hz ±10% with 60dB/decade
22.4Hz to 22.4kHz BP	-3dB at 22.4Hz and 22.4kHz ±10%, 60dB/decade
A-Weighting filter (opt)	according to IEC 651
Custom design filter (opt)	4-pole active filter with selectable cut-off frequencies

DISPLAY

256 x 128 dot matrix LCD module with backlight
Measurement display with 15mm numeric values and two 100mm bar graphs. Graphics display for sweep- and scope representation

Interfaces

Printer	Centronics compatible, parallel interface (25 pin sub D) for graphic and text printouts.
RS 232	Serial port (optional) for remote control and data transfer between A2 and an IBM PC compatible computer.

General Data

Dimension	274 x 396 x 132mm
Weight	approx. 7.5kg
Power requirements	100, 120, 230, 240VAC / 60VA
Temperature Range	0 to 45°C
Humidity	<90% relative humidity (non condensing)